# Opening Ceremonies

## Welcoming Remarks

### Nicole Pageot

Director General
Road Safety and Motor Vehicle Regulation
Transport Canada
Canada

Ms. Pageot, as Conference co-chairperson, began by thanking the sponsors, delegates and attendees. She stated she was delighted Tranport Canada had the opportunity to host the 16th ESV Conference in Windsor and hoped that everyone would partake in the beauty of the city. Ms. Pageot then introudced the Conference co-chairperson and sponsor, Dr. Raymond P. Owings, Associate Administrator, National Highway Traffic Safety Administration.

### Raymond P. Owings, Ph.D.

Associate Administrator
National Highway Traffic Safety Administration
United States

Thank you Nicole. Minister Collenette, Dr. Martinez, distinguished guests, ladies and gentlemen. It is an honor and distinct privilege for me to co-chair this technical conference with Ms. Nicole Pageot, to explore new and innovative motor vehicle safety research opportunities.

I would first like to express my appreciation to Transport Canada for hosting this important event and to the City of Windsor for their warm hospitality. Also, to you the authors and delegates, I extend a warm welcome and thank you for being a part of this international exchange. Sixteen nations will be represented during this conference by way of oral presentations, poster presentations and written papers.

This, the 16th ESV Conference, will mark the end of the millennium for this forum. The next time this group comes together we will have entered the 21st Century. It is our hope at the National Highway Traffic Safety Administration that the new century will lead us to the road to zero fatalities, not only in the United States, but for our global partners as well. We at DOT believe the ESV Conference is a vital part of this road. Perhaps the best testimony to this can be found in the words of Professor Praxenthaler eighteen years ago during his welcoming address to the delegates of the 8th ESV Conference. And I quote "These conferences have a tradition which has caused experts and automobile users alike to listen rather carefully; ...these conferences generate initiatives - and if it were possible to trace their complex routes - we would learn that these initiatives have saved many lives and reduced injuries." end quote.

It is through the vital work and expertise of you, the researchers, engineers, and doctors, through commitment of you, the decision-makers; through you, the academia who ensure that this science does not die in our educational institutions, and through our recently initiated harmonized research activities, that we all will continue to save lives and reduce injuries globally.

For the past two years, we at the National Highway Traffic Safety Administration have been working with our host Transport Canada, to again bring you the most scientifically sound technical conference. We set a record for this conference - over 300 technical abstracts were submitted for consideration. We are thankful to the ESV Government Focal Points, and the Technical Session Chairmen for their diligence in making selections for oral and poster presentations. This is never an easy task. This conference marks the first time poster presentations will be on display. I encourage you to visit the displays and provide feedback.

On behalf of the government of the United States, I welcome you to the 16th ESV Conference.

Thank you.

# Keynote Addresses

## Ricardo Martinez, M.D.

Administrator
National Highway Traffic Safety Administration
United States

Good morning. Thank you Minister Collenette, Ms. Pageot, Dr. Owings and all of you. I bring greetings from the United States Secretary of Transportation Rodney E. Slater.

Secretary Slater sends his regrets, but wants you to know that safety is his top priority and the top transportation priority in the United States. It is our North Star, by which we are guided in all our transportation decisions. He wishes you a successful and enlightening conference.

What an exciting and most opportune time for us to come together. Vehicle safety is, and will always remain, a high priority for everyone in this room. But as we loom on the cusp of a new millennium, we must understand the challenges of today and turn them into the opportunities of tomorrow.

Four years ago at NHTSA, we committed ourselves to doing just that. With our fatality rate, seat belt use and drunk driving statistics stagnant, we realized that the easy gains in traffic safety had been made and that we had three big options to achieve further success: big government, big budget, and big change. We knew that big change was the best answer.

Working as a team, we made NHTSA fast, friendly, and flexible with an outward focus. We recognized that information is a perishable commodity and worked to develop an international research agenda that would leverage all of our resources and speed the creation of knowledge and development of solutions.

We took a look at our partners and realized we were limiting our involvement to a small segment of those that could help. Safety is not just an industry problem and it is not just a government problem – it is **everyone's** problem. We engaged and mobilized others – traditional and nontraditional partners at the national and international levels. We have lit a fire and we want it to spread.

By putting a human face on the safety issue – we are showing America that everyone has a responsibility to find solutions to this problem. Safety is not about protecting dummies, but about saving people.

We are now focusing on safety for the right reasons. It is not just a regulatory issue, or a cost issue, or a legal issue. It is, and always has been about people saving people.

The lessons we have learned at NHTSA over the past four years have relevance to this esteemed group at this premier safety conference. For you, I have a simple message: Opportunity knocks.

The traditional approach has been to focus exclusively on the crashworthiness of the vehicle. This has lead to tremendous advances in safety and, as a physician, I have seen people survive in crashes that previously would have been fatal.

But, so too for the vehicle, many of the easy gains have been made. What will the next ESV conference and the next century bring forward as safety advances?

There are three clear steps we must take: broaden the scope of our approach, expand the dialog with others, and create the tools and resources to support these changes.

We must broaden the scope beyond crashworthiness to focus technologies on crash avoidance and post-crash injury control. Among other things, crash avoidance technologies provide early warning systems, navigational aids, enhanced visibility and hazard notification, assisted braking and steering systems, and delivery of information and communications. With 90 percent of crashes caused by human actions, crash avoidance clearly has an enormous payoff, yet it is unclear if emerging systems will decrease or increase the task of driving.

It is an unfortunate truth that we know more about the vehicle than the human in it. At the same time that we are aging as a population, we are adding information systems and sophisticated technology to the driving task. We must know much more about the "Human-machine interface" if we are to optimize these systems.

Minimizing the seriousness of an injury after a crash often depends on early access to medical care. More than half of all fatal crashes in America are single vehicle and in a rural environment. In the chain of survival, delays in discovery, access to communications and accurate notification of medical responders diminishes a crash victim's chance of survival. In

emergency medicine, we say "time is tissue." Again, using technology, we can eliminate these delays and extend the medical safety net to those who need immediate help.

NHTSA's Automated Collision Notification (ACN) system technology is already being tested in 500 vehicles in Buffalo, New York and could be available nationwide within five years. Six crashes have happened to date and the box worked properly in all cases, sending global positioning system coordinates, direction and force of impact, and calculating a probability of injury. But to work, the emergency medical system must be able to receive the calls and use the information. We are working with multiple partners to build the receiving communications and dispatch network.

Both these opportunities for saving lives are practical and doable, but neither can be done by just those in this room. Pre-crash and post-crash, and even the crashworthiness, technologies require us to expand the dialog to others and create a "living link" with other professional disciplines. For example, crash avoidance engineers should integrate with specialists in aging, vision, rehabilitation, mental cognition, and neuropsychology. Vehicle crashworthiness engineers should integrate with medical researchers, practitioners, and rehabilitiationists. Post-crash engineers should integrate with emergency responders, dispatchers, and medical providers.

We cannot be insular and isolated in our knowledge in a world of flowing information. The interface between knowledge disciplines is critically important. When sharp divisions occur between disciplines, knowledge falls through the cracks and is lost or missed. When boundaries overlap, we create a safety net for people and stimulate innovation and creativity.

Lastly, we are already creating the tools to build our bridge to the future. The National Advanced Driving Simulator (NADS) is the next generation of simulators and will be the most advanced and sophisticated in the world when it is completed next year. It takes us closer to real world driving conditions than any before it.

We talk about putting a black box in cars – but the real black box is the human being. NADS helps us understand that human/vehicle interface and will help us better understand how humans respond at the limits of performance without truly putting them in harms way. We will also use NADS to study the human/environment interface by generating various road, intersection, and signage designs under a variety of conditions. Fabrication has begun and hope to be operational in March, year 2000.

The Crash Injury Research and Engineering Network (CIREN) links seven trauma centers, from across the country, to engineers in the labs in order to study the cause, effects and results of real world crashes.

CIREN centers have multidisciplinary teams of physicians, medical researchers, safety engineers, crash reconstructionists, public safety professions, and others who review the crash and the patients.

CIREN brings us back to our basic concept of creating a living link between those that take care of injuries and those that design the vehicles. We must always keep one foot in the crash lab and one foot in the real world.

To sustain our progress in vehicle safety, we cannot afford to have our medical personnel taking care of injuries without understanding what happened in the crash. We cannot have our engineers developing and designing systems without understanding the variability of both real world crashes and their occupants.

CIREN allows us to go from the field to the facility to the drawing room.

I encourage all of you to create strong relationships with your trauma centers, emergency departments and rehabilitation centers in your own areas. Have your staff rotate through them on a regular basis. My staff routinely visit these centers throughout the country because they are our learning forum. That is where our customers are.

With these technologies we have an opportunity to break new ground and open the doors to new knowledge that can be used to improve public health and safety.

Working with national and international partners, like many of you here today, we will continue to advance the safety issue.

It is about asking the right questions. And looking around the room, I have to ask a question – are all the right people here to help bring us into the new millennium – to help solve the safety issues of the 21st century?

If not, we need to rethink and review our mailing list right after this meeting is over. We want to continue to create the tools and resources, to engage, energize and mobilize all our constituents.

And let me say, "thank you" to all of you. As Administrator, emergency physician and particularly as a father, I know there are few things I can control regarding the safety of my loved ones once they leave home.

It is the work of people like yourselves that makes all the difference in the world. When I and my staff

visit these trauma centers, it is exceedingly clear that what you do keeps our loved ones safe.

I urge you to rise to the challenge. Expand the approach to crash avoidance and post crash protection, recognize the "living link" of expanded dialog, and let's create the tools and resources needed to support these changes. Together we can build a bridge to the 21st century that ensures safe passage for generations to come. Thank you very much.

## The Honorable David M. Collenette

Minister of Transport
Canada

Good morning, ladies and gentlemen.

It gives me great pleasure to be here at the 16th Enhanced Safety of Vehicles Conference today. I'd like to begin by welcoming everyone to Canada and, more specifically, to Windsor. I hope you will have time to visit the area before you leave to return home.

We at Transport Canada consider the ESV conferences an invaluable opportunity for researchers and for industry and government representatives to share recent advances in motor vehicle safety technology. By promoting co-operation in research and the international harmonization of safety regulations, conferences like these play a major role in improving the safety of road transportation in Canada and indeed throughout the world. That's important for everyone.

In Canada, we have witnessed a 50 per cent decline in traffic fatalities over the past 25 years, even though traffic has doubled. The figures for 1997 are the lowest since these statistics began to be compiled.

But even one fatality is one too many. We — and by "we" I mean the federal and the provincial and territorial governments — are committed to making Canadian roads the safest in the world. Statistics from the Organization for Economic Cooperation and Development indicate that Canada now ranks seventh in terms of fatalities. We will continue to work on improving our record and will be looking to other countries to see what initiatives have worked best for them.

### Safety is Everyone's Concern

My departmental officials have implemented a wide range of activities to bring us closer to our goal. After all, regulation and infrastructure improvements can only do so much. Public awareness and public commitment are also critical to road safety.

That's why we're working with government and industry partners through the National Occupant Restraint Program to increase the use of safety restraints in vehicles, for example. Our goal is for 95 per cent of occupants of light-duty vehicles to consistently buckle up by the year 2001.

We have already seen positive results — much of the recent improvement in road safety can be attributed to increased seat belt use, which is currently at 92 per cent for Canadian drivers. We are quite proud of this statistic, which is among the best in the world. It is the direct result of collaborative work on improved seat belt design, seat belt and child restraint legislation, police enforcement programs and public education efforts.

Similarly, our Strategy to Reduce Impaired Driving aims to reduce injuries related to drinking and driving by 20 per cent, also by the year 200 1.

The need for improved communication about safety issues is underscored by a recent survey. Despite the fact that road fatalities are down 15 per cent, nearly half of Canadians polled believed that the safety of our roads had declined over the last five years.

We're working closely with our partners to improve the public's confidence in the safety of our road transportation system.

### Protecting Our Children

We are currently focusing our efforts on children. A recent survey gives cause for concern — at least 25 per cent of children on Canadian roads are either not properly restrained in child seats, or are in seats that are inappropriate for their size and weight. In most cases, the parents thought they were securing their children safely. Clearly, there is a need to provide the public with more information about the proper use of child restraints.

To address this need, I have requested the development of a national public awareness campaign — targeted at parents and other caregivers — to increase awareness of the dangers of improper use of these devices.

Transport Canada staff are developing promotional materials such as videos, brochures, and pamphlets, which will be available later this year. The department is also working on improving safety regulations to

ensure that manufacturers make child restraints that are easy to use properly.

To make our regulations as effective as possible, Transport Canada — with the Children's Hospital of Eastern Ontario (CHEO)— is planning a two-pronged multi-disciplinary study of children involved in real-world motor vehicle crashes.

The first component is a study, based in the national capital region, of all children who are admitted to CHEO as a result of a motor vehicle collision. The second takes the national perspective and will involve several hospital and university-based collision investigation teams. This study will focus on children who sustain injuries from seat belts or air bags.

The objective of these studies is to collect detailed information about the nature and severity of motor vehicle collisions involving children, and the injuries that result. We believe that the combination of the automotive safety engineering expertise of Transport Canada and the medical knowledge of the participating physicians will help the industry to produce better occupant restraint designs. It will also serve to help target public awareness campaigns that promote proper child restraint use.

Transport Canada is working hard to improve the safety of motor vehicles generally.

**Fine-Tuning the Equipment**

Out of concern about injuries caused by air bags, we recently conferred with the provinces and territories, with the U.S. National Highway Traffic Safety Administration (NHTSA), and with vehicle manufacturers and dealers to develop an air bag deactivation program for the rare cases where deactivation might be warranted. The program is now in place, and explanatory brochures and application forms are available for anyone considering such action.

This is not to say that air bags are unsafe. Quite the contrary. I want to emphasize that air bags provide an additional level of safety beyond seat belts. It has been estimated that air bags have saved nearly 150 lives since their introduction in Canadian vehicles in the early 1990s.

Moreover, we are pleased to note that vehicle manufacturers have responded to concerns with the introduction of second-generation air bag systems that deploy at lower speeds, thereby reducing the risk of injury. Most 1998 models sold in Canada have these second-generation air bags.

And Transport Canada researchers are currently working with NHTSA to develop even more advanced air bags — a third generation if you will — which deploy according to variable parameters, depending on occupant characteristics and collision circumstances.

Side-impact protection is another area of vehicle design that we believe can save lives. We've launched a major research program to study real side-impact collisions and to conduct crash tests, in order to develop new, dynamic requirements for side-impact protection. We are working closely with our colleagues in the U.S., the European Union, Japan and other countries to develop the first internationally accepted side-impact test dummy. This is important in today's world of international manufacturing and global markets.

**International Harmonization**

To further contribute to international research in road safety, Canada has also been participating in international harmonized research working groups under the auspices of ESV. This is important research, and we intend to continue our participation for some time to come.

And we are working through NAFTA, APEC and the United Nations Economic Commission for Europe to promote the international harmonization of motor vehicle standards to improve road safety all over the world.

Which isn't to say that we're trying to make everyone conform to the same detailed regulations. Every country must take responsibility for safety in its own jurisdiction and will, of course, reserve the right to set unique standards and regulations to meet the requirements of its own citizens. A good example of this is Transport Canada's 1990 regulation requiring daytime running lights in Canada — a move that resulted in about a 10 per cent reduction in collisions.

My department is currently revising the Motor Vehicle Transport Act, which regulates the safe operation of trucks and buses in Canada. We are aiming to improve not only road safety, but also the competitiveness of the Canadian motor carrier industry with our amendments. I hope to table this Bill in the House of Commons later this year.

**Technology**

Technology plays a major role in transportation today and must be part of any plan to improve our systems.

Wide-spread recognition of the potential benefits of Intelligent Transportation Systems (ITS) to the efficiency of the Canadian transportation system have resulted in millions of dollars in investments towards the development of such improvements as route guidance systems, collision avoidance systems and

heads-up displays.

Still, this new technology will have to be proven safe before it can be used. Safety has always been — and will always be — Transport Canada's top priority, and we have been working closely with other countries through the IHRA [International Harmonized Research Activities] to develop methods of assessing the human factors involved in using this technology.

Which brings me to the theme of this year's conference — the need to take the human factor into consideration in developing new safety technology.

This is of critical importance. Research demonstrates that human factors are responsible for some 90 per cent of motor-vehicle collisions.

We must make new safety technology user-friendly, as well as efficient, so that people will use it — and use it right. We will not sacrifice safety for efficiency.

But there is another safety issue I'd like to mention here-that's technology-related.

**Year 2000 Issues**

As we approach the year 2000, we have more to look forward to than a giant birthday party. The turn of the century also poses what could be a huge technological challenge, in the form of the so-called "millennium bug."

Computers all over the world, including those that control transportation manufacturing and systems, could be affected.

As the department responsible for regulating transportation safety in Canada, we are encouraging industry to become more aware of the problem and its implications for transportation safety. We recognize the potential for problems related to this computer glitch and have created a working group to systematically examine attendant safety concerns.

While we are confident that industry will find effective solutions, we will nonetheless monitor the steps the various federally regulated transportation modes are taking to address the issues.

We will assess industry's progress in dealing with all potential problems well in advance. We have adequate regulatory authority under existing legislation to take action if concerns about safety continue — and we can and will respond promptly if necessary.

**Meeting the Safety Challenge**

Ladies and gentlemen, I've outlined the challenges we are facing with regard to road transportation safety and delineated some of the steps we in Canada have taken to meet those challenges.

While there's no such thing as absolute safety in transportation, we intend to get as close to that as technology and hard work will allow. And we're doing well. Despite the impression sometimes left by the news media with their focus on accidents, Canada has an enviable safety record.

A record like ours doesn't just happen. It results from a commitment to safety on the part of all the players — a commitment that is backed by effective federal regulation and enforcement of national standards.

My hope is that by pooling our knowledge at conferences like these we can make a positive difference in the safety of transportation the world over.

Ladies and gentlemen, thank you.

# U.S. Government Awards Presentations

Presenter: Ricardo Martinez, M.D., Administrator
National Highway Traffic Safety Administration, United States

## U.S. Government Awards for Safety Engineering Excellence

In recognition of and appreciation for extraordinary scientific contributions in the field of motor vehicle safety engineering and for distinguished service to the motoring public.

## Canada

**Eric R. Welbourne**
Transport Canada

Mr. Welbourne has demonstrated exceptional leadership in the research field of human biomechanics and vehicle crashworthiness in support of motor vehicle safety regulations. His work has advanced fundamental understanding of human response in vehicle crashes. In particular, his modeling work has contributed to the advancement of scientific knowledge concerning the biomechanics of injury involving the head, chest, and lower extremities. As a result of this research, important changes to Transport Canada's occupant protection policies and vehicle safety regulations have been made. For these contributions to automotive safety, he is being recognized with this award.

## France

**Jean-Yves Le Coz**
PSA Peugeot/Citroen/Renault

Dr. Le Coz has dedicated his professional life to obtaining greater knowledge in the field of road safety. Leading collaborative laboratory efforts with vehicle manufacturers has resulted in the development of passive safety and collision avoidance technology responsible for the development of safer vehicles. His professionalism and competency in providing the scientific population with laboratory accidentology and biomechanics research knowledge is deserving of this special recognition.

## Germany

**Klaus Oehm**
Volkswagen

Mr. Oehm has worked in the field of motor vehicle safety research for over 25 years. Mr. Oehm played a leading role in the development of the first passive restraint system to go into series production. In 1996 Volkswagen introduced in the *Golf*, a seat-integrated side airbag system for front seat occupants. The *Golf* became the first car in its class to be offered with this occupant protection system. Mr. Oehm was among those primarily responsible for the development of these systems. Many members of the motoring public have been protected in a variety of crashes world wide through the outstanding efforts of Mr. Klaus Oehm. For these contributions to international automotive safety, he is being recognized with this award.

## Japan

**Tetsuo Tsuchida**
Honda R&D Company

Mr. Tsuchida is being recognized for his contributions in enhancing the safety of motorcycles. He was responsible for the development of a combined front-rear anti-lock braking system which lead to improved operation of motorcycles and greatly contributed to rider injury prevention. This improved safety technology was applied to mass production for large motorcycles and small scooters. For his contributions of improved safety operation of two wheeled vehicle brake systems, Mr. Tsuchida is being recognized.

## Sweden

**Ingrid Skogsmo**
Volvo Car Corporation

Mrs. Skogsmo has been instrumental in the development of several new and unique test methods and injury assessment criteria. Under her leadership at the Volvo Safety Center, the department has successfully developed criteria and provided research in the development of Volvo's most recent safety innovation, the Inflatable Curtain and the Whiplash Protection Study. Her work with side impact methodology and criteria has been implemented in the well known Side Impact Protection System, SIPS, and in 1994, the development of the side impact airbag, SIPS-Bag. For her contributions to motor vehicle safety worldwide, Mrs. Skogsmo is deserving of this special recognition.

## United States

**John W. Melvin**
General Motors Corporation

Dr. Melvin has devoted over 30 years of his career to improving motor vehicle safety. He is being recognized for his significant contributions to automotive safety through his unique capability to apply knowledge in biomechanics to enhance safety design. His research in biomechanics has helped to improve the design of airbags, belt restraints, seats, and interiors in today's passenger cars. His pioneering work in demonstrating how protection can be enhanced in high energy crashes on race tracks has helped lay the groundwork to extend that knowledge to passenger car protection. Dr. Melvin is deserving of this special recognition.

# U.S. Government Special Awards of Appreciation

In recognition of and appreciation for outstanding leadership and extraordinary contributions in the field of motor vehicle safety.

## Poland

**Wojciech Przybylski**
Motor Transport Institute

Mr. Przybylski is being recognized for his leadership and vision to promote motor vehicle safety in Poland. He is also being recognized for his efforts in international cooperation for motor vehicle safety regulations. He has forged a closer connection for Poland and motor vehicle researchers in different countries through his entry into the ESV Technical Conference and active participation in the International Harmonized Research Activities. For his dedication and commitment to enhancing motor vehicle safety worldwide, Mr. Przybylski is being recognized with this award.

## Sweden

**Lennart Johansson**
Volvo Car Corporation

With an expansive career in motor vehicle crashworthiness research and development, Mr. Johansson is a leader in improving motor vehicle safety. His unique ability of understanding the urgent need to develop and introduce new restraint systems for the occupant's best protection, and his leadership to get the best performance restraint systems on the market as early as possible has contributed to motor vehicle safety worldwide. For these contributions, Mr. Johansson is being recognized with this award.

## United Kingdom

**C. Adrian Hobbs**
Transport Research Laboratory

Mr. Hobbs' research on the behavior of car structure in frontal impacts, and their influence on injuries to occupants, lead to the development of the European Enhanced Vehicle Committee's (EEVC) Offset Deformable Front Impact test procedure. Mr. Hobbs has been involved in motor vehicle safety research since 1972, and is now one of the leading experts in understanding the structural behavior of cars in crashes. For this and his numerous contributions to improving motor vehicle safety, Mr. Hobbs is being recognized with this award.

## United States

**H. George Johannessen**
OmniSafe, Incorporated

Mr. Johannessen has contributed more than thirty years of dedicated service in advancement of vehicle occupant safety through professional engineering efforts and public education. Mr. Johannessen has served on numerous national and international automotive safety-related committees and has demonstrated outstanding leadership to further the understanding of motor vehicle safety. Mr. Johannessen is deserving of this special recognition.

## United States

**Richard F. Humphrey**
General Motors Corporation

Mr. Humphrey is being recognized for his unique and extraordinary contributions to promote the cause of safety through highly effective communications in motor vehicle safety matters. Mr. Humphrey is an active participant on various committees, and works with numerous transportation related activities to promote understanding of issues and to achieve solutions beneficial to the motoring public. He is an accessible technical expert, a coalition builder, and an influential advocate for improving motor vehicle safety. For his service and dedication to the safety of the motoring public, Mr. Humphrey deserves special recognition.

# U.S. Government Special Recognition Presentations

## ESV Distinguished Service Award

**Linda L. O'Connor**
National Highway Traffic Safety Administration (Retired)
United States

In recognition of and appreciation for your distinguished service. The United States Department of Transportation, National Highway Traffic Safety Administration, our International Partners, (Germany, France, Italy, Japan, The Netherlands, The European Commission, United Kingdom, Sweden, Canada, Belgium, Australia, Hungary, and Poland) and the motoring public present you with this award. Your involvement in coordinating, organizing, and providing the ultimate leadership at the International Technical Conference on the Enhanced Safety of Vehicles (ESV) as ESV Technical Coordinator is an extraordinary achievement.

## ESV Appreciation Award

**Vittoria Battista**
Transport Canada
Canada

On behalf of the U.S. Department of Transportation, it is my pleasure to recognize you for your outstanding achievements as the Program Manager, for the 16th International Technical Conference on the Enhanced Safety of Vehicles, May 31 to June 4, 1998, Windsor, Ontario, Canada. The National Highway Traffic Safety Administration is grateful for your work and commitment to motor vehicle safety research. Your talents and organizational skills served to facilitate the international exchange of technical information.

# Government Status Reports

Chairperson: Jean-Pierre Médevielle, INRETS, France

## Commission of the European Community

**Herbert Henssler**
European Commission

**Abstract**

This paper reviews the activities of the European Community in relation to the EC Type-Approval legislation for motor vehicles and its safety-related requirements which occurred since the last ESV-Conference.

The importance of the accession of the EC to the 1958 Agreement of the UN/ECE motor vehicle regulations is emphasised and its effects on the regulatory activities are explained

The new directives on the protection of car occupants in front and side impacts are presented as well as the intended legislation on the protection of pedestrians in the event of collision with cars. Furthermore, the paper outlines the current activities aiming at enhanced safety of buses and coaches, child restraints and frontal protection for trucks. The paper also gives an overview on safety related research projects, which are promoted by the EC in the framework of its R & D programme.

### Introduction

Mr. Chairman, I wish to thank you on behalf of the European Commission for the invitation to present again the report on the regulatory activities of the European Community in the automobile safety sector. Many important developments have occurred in the EC since the last ESV Conference in Melbourne two years ago, and I am pleased to report on these here at this outstanding forum. The activities of the EC cover, of course, all the important aspects of road safety: traffic regulations, driver related regulations and regulations relating to the vehicle construction. As the competence of the department I am representing is limited to the latter aspect, I will focus my presentation on the developments in the area of vehicle safety.

### The Accession to the Revised 1958 Agreement of the UN Economic Commission for Europe

The most important development which took place in the interval considered has been the accession of the EC to the Revised 1958 Agreement of the UN/ECE on 24 March 1998. The internal process of the EC on which I had reported at the previous Conference has been achieved on 29 November 1997 by a decision of the Council of Ministers with the assent of the European Parliament.

The decision to accede to the Agreement is of paramount importance for the evolution of the automobile regulations of the EC. On the one hand the ECE regulations to which the EC adheres -78 so far- will be directly applicable and give access to the internal market of the EC. Where of interest to the EC, ECE Regulations could quite simply be carried over into the EC Type-Approval system and thus be made mandatory on its internal market. On the other hand, as a Contracting Party to the Agreement the EC can now actively participate, in accordance with its economic importance, in the process of establishing technical regulations in this international forum which has, among other things, a high reputation as the key international regulatory body in the area of vehicle safety. In this context the Commission welcomes the recent news from Tokyo on the approval by the Diet of Japan's accession to this Agreement.

In the interest of transforming the ECE in Geneva into a truly global forum, embracing also Canada and the US, Commission representatives have actively cooperated with the American and Japanese experts to establish a tri-partie proposal for a complementary agreement which has been submitted to the Working Party 29 of the ECE at its March session of this year. At its forthcoming June session, comments of this proposal which are introduced by other interested parties will be discussed. It is the intention to open this agreement for signature as soon as possible.

### EC Type-Approval

As reported at the previous Conference, the EC type-approval became mandatory, on 1 January 1996, for all vehicles of the international category M1: that is passenger cars and similar vehicles such as motor

caravans. From 1 January 1998, each car sold and registered in the EC must have an EC Whole Vehicle Type-Approval unless it is built individually or produced in small series. In relation to this latter obligation, the EC Type-Approval procedure has been reviewed early this year in order to make its administrative aspects more practicable and expedient. The work in order to extend the provisions of the EC Type-Approval to all other vehicle categories is making good progress and a decision is expected in the near future.

The accession to the 1958 Agreement will also require adequate amendments of the EC Type-Approval in view of the direct applicability of ECE-Regulations within this procedure. This work has recently been started.

Whilst the initial and fundamental objective of EC Type-Approval has been a commercial one, i.e. to achieve the internal market of the EC in the vehicle sector, the current provisions of the Treaty of the EC on which this procedure and its technical requirements are based, require that a high level of safety, environment and consumer protection must be assured by such regulatory initiatives.

Hence, the EC Type-Approval constitutes the ideal basis to introduce, for the whole of the EC, stringent requirements relating to the construction of vehicles, vehicle systems and components which affect safety and environmental protection. Another consequence of this fundamental requirement is that the Commission has to carefully monitor the progress of the automotive technology in order to adapt the technical requirements of the EC Type-Approval to the state of the art whenever appropriate.

Equally, the increasing public pressure for improved road safety and environmental protection is a motivation for the Commission to amend existing directives or to establish proposals for new directives. Here again, the accession to the 1958 Agreement will make this task of the EC easier as full use of the expertise of the ECE working groups will in the future be possible.

In the following I will elaborate essentially on the progress made on regulations relating to the safety of vehicle occupants and pedestrians, issues where we have identified considerable need for improving the present situation.

**Protection of Occupants in Front and Side Impacts**

The 2 directives which were under discussion at the time of the Melbourne Conference have been adopted by the Council and the Parliament of the EC in May 1996 and December 1996 respectively (directives 96/27/EC and 96/79/EC).

The directives reflect the most recent state of the art, both as far as the representative with respect to real-world accidents in the EC and the biomechanical aspects are concerned. The rationale for and the contents of these directives have been explained at the previous Conferences. It is simply recalled that Directive 96/79/EC on front impact protection specifies a test of the vehicle to be approved against a fixed, off-set, deformable barrier at 56 km/h. The biomechanical criteria for assessing the protective characteristics of the vehicle relate to the head, neck, thorax, femur and lower leg.

The Directive 96/27/EC on lateral impact protection relies on a test with a mobile deformable barrier against the stationary vehicle at 50 km/h. The biomechanical protection criteria relate to the head, thorax and pelvis.

As initially proposed, both Directives become mandatory, for new types of cars, from 1 October 1998, and for all new cars entering the market and registered in the EC from 1 October 2003 onwards.

When Council and Parliament adopted these directives they gave precise instructions to the Commission concerning the review of certain details at short term and the further evolution of their specifications at longer term. The work concerned has been entrusted to the European Enhanced Vehicle-Safety Committee (EEVC) which will report on this in more detail in their status report

**Protection of Pedestrians and Other Vulnerable Road Users**

Legislative measures aiming to ensure that car fronts are as "pedestrian friendly" as possible are under discussion in Europe since several years and continue to figure on the work programme of the Commission.

In view of the considerable differences in the evaluation of the cost of such measures in relation to their benefits, the Commission has entrusted a renowned institute with a comparative study of the available cost/benefit assessments in order to get a conclusive opinion on this aspect. The results of this study have been presented in January 1998 to a meeting of experts from the national administrations, industry and consumer organizations. At the end of this meeting, the majority of the consulted experts were affirmative both as regards the need and the technical feasibility of the intended measures.

In the meantime, EEVC which, 4 years ago, had developed the test methods and protective criteria which are the basis for this directive, has accepted to review the specifications concerned in order to take account of the most recent accident studies.

On this basis, the Commission will be in a position to finalize its proposal for a comprehensive, performance-related directive and submit it to decision makers of the EC for adoption.

**Safety of Buses and Coaches**

The safety of persons transported in buses and coaches remains a priority area of the regulatory programme of the EC.

The proposal for construction requirements for buses and coaches which has been announced at the Melbourne Conference, has been presented to the European Council and Parliament in October 1997.

Once adopted, this directive will set specifications for rollover strength and stability, stipulate the number and dimensions of exits for normal use and for use in emergency evacuation, and establish minimum dimensions for seats and gangways. Administratively, the directive will allow for the type-approval of buses and coaches as complete vehicles and, for the benefit of specialized bus body manufacturers, also of the bodywork as separate technical units.

As far as the above mentioned requirements are concerned the directive follows the corresponding regulations of the UN/ECE. A specific feature which the EC Commission has added to its proposal are mandatory requirements relating to the accessibility of buses and coaches for persons with reduced mobility.

The discussions of this proposal in the Parliament and Council are underway and it is hoped that the final adoption by these institutions will occur before the end of this year so that the intended implementation date of 1 October 1999 can be respected.

In the meantime, the Commission has amended, by means of the procedure of adaptation to technical progress, three existing directives relating to seat belts, seat belt anchorages and the strength of seats in order to introduce the mandatory fitment of seat belts, and in some cases energy absorbing seats, in all seating positions of medium and large buses and coaches. The directives specify the fitting of 3-point belts in minibuses, where the risk of injury in frontal impacts is high, and 2-point belts and energy-absorbing seats in large coaches, where the main risk of injury relates to ejection during roll-over.

These measures entered into force on 1 October 1997 for new types of buses and coaches and will become mandatory on 1 October 1999 for any new such vehicle sold and registered in the EC. (For mini-buses with a total mass of less than 3.5 tons the implementation dates are October 1999 and October 2001.)

In order to acquire the necessary technical background for further improving the safety of occupants of buses and coaches, the Commission has entrusted a European consortium with a comprehensive study of state-of-the-art test procedures and requirements for restraint systems specifically conceived for such vehicles. The results of the study will be presented at this Conference.

**Child Restraints**

Taking account of the public interest of enhancing the safety of small children transported in passenger cars, the Commission has introduced this issue into its regulatory work programme.

With its accession to the 1958 Agreement the EC has adhered to the Regulation 44 of the ECE relating to safety of the construction of child restraints. This regulation represents the relevant state of the art and is already widely applied in Europe. The Commission intends, therefore, to add the reference to the technical specifications of this regulation, together with appropriate installation requirements, to the existing directive 78/541/EC relating to safety belts and restraint systems, currently limited to specifications for such systems for adult occupants.

This process will be carried out by the Commission in the framework of adaptation of the existing directive to technical progress and is expected to be achieved before the end of this year.

**Front Underrun Protection for Heavy Commercial Vehicles**

Public concern in Europe about frontal collisions between trucks and cars where the latter underrun the front structure of the truck is increasing and has induced the Commission to add this issue to its regulatory work programme.

Here again the EC has adhered with its accession to the 1958 Agreement to an existing ECE Regulation (n° 93) which specifies a static test procedure for front protective devices for heavy commercial vehicles. The devices resulting from the application of this regulation have proven to be a cost-effective way to reduce the consequences of a frontal collision with a truck for the occupants of a passenger car. The Commission therefore intends to propose to the European Parliament and Council to adopt a new separate directive in order to introduce the technical

requirements of the Regulation 93 into the EC Type-Approval system. This proposal is expected to be ready in the course of 1998.

**Support to Research Projects**

In order to contribute, in general, to the efforts to reduce the number of fatalities caused by road accidents and, in particular, to establish a scientific basis for the evolution of the European legislation in the field of passive safety, the EC Commission sponsors a considerable number of relevant research projects through its R&D budget.

The current R&D programme focuses on the question of vehicle compatibility in different accident modes, the improvement of the representativity of the test procedures relating to frontal and lateral impacts including the development of advanced anthropomorphic dummies and the different aspects of pedestrian protection.

The partners of the Commission are, as already mentioned, the EEVC, other research institutions and universities and also the European automotive industry and its suppliers interested in passive safety.

For the next R&D programme it is proposed to establish a European network on passive safety in order to link together and coordinate the different projects funded by the EC and its Member States.

It is intended, where it is of interest, to establish a relationship between this network and the International Harmonized Research Activities (IHRA) process in view of establishing a world-wide research basis for future regulatory initiatives.

I have noted that in the technical sessions of the Conference, different papers will refer in more detail to these research projects.

**Conclusions**

Subject to the conclusion of the work on pedestrian protection the EC Type-Approval procedure and its technical requirements are in principle completed for passenger cars. The next future will see the Commission to focus its activities on the extension of this procedure to the other categories of road vehicles. This will, in the area of vehicle safety, require a few new directives and the appropriate amendment of the technical requirements of a number of existing Directives. The work to this aim is under way and I hope that substantial progress can be reported at the next ESV-Conference.

The accession to the Revised 1958 Agreement will of course affect the future regulatory process of the EC, as it offers now the possibility to develop technical regulations affecting the design and construction of motor vehicles in the future on a wider international basis.

We welcome in this respect Japan's decision to adhere also to the Agreement, and that Australia has taken steps to start the internal process in view of its accession. We hope that other important motor vehicle producing countries in the world which are not currently Contracting Parties will follow and also join this Agreement in the interest of free global trade unimpeded by technical obstacles.

We are also supportive of the initiative of the United States to create a complementary agreement aiming at the establishing of global technical regulations as this would eventually establish the basis for an effective world-wide harmonisation in the automobile sector.

This achievement would not only be beneficial to our industries but also to their customers in the whole world who would be able to acquire motor vehicles offering a high standard of safety and environmental protection at reasonable cost. I consider this conference as being an excellent contribution to this objective.

I thank you for your attention and wish the Conference and its organisers a great success.

# Federal Republic of Germany

**K.-H. Lenz**
Bundesanstalt für Straßenwesen

It is an honour for me to present the status report of the German Government at the 16th ESV Conference again this year.

**Road Construction and Traffic Engineering**

As already mentioned at the last ESV Conference, approximately 47 % of the total distance travelled by motor vehicles is accomplished on federal trunk roads. The concentration of motor vehicle traffic on the federal autobahns is particularly high. Approximately 30 % of the vehicle kilometrage is completed on autobahns even though they constitute only approximately 1.8 % of the total road network length.

In 1993, on the basis of the 1992 Federal Traffic Infrastructure Programme, the German parliament passed the 4th Act Amending the Improvement of Trunk Roads Act with a requirement plan for the expansion of the federal trunk roads which provides for an investment volume of approximately 210,000 million DM by the year 2012 for urgent projects for improving and enlarging the road network.

The increase in the efficiency of the roads which results from increasing their width to six or eight lanes increases the capacity and improves the quality of traffic flow and operation. The present total length of autobahns with six or more lanes in the federal autobahn network is 1698 km including constructions completed in 1996 (approx. 15 % of the network). Federal autobahn expansion is focused primarily on the roads being improved as part of the "German Reunification" traffic project and on the main through-traffic autobahns A1-A9 which are subject to heavy loads; these are the European roads, which run through Germany from one national border to another. Extensive investments continue to be made, above all in the autobahns in the new federal Laender and particularly in measures for increasing traffic safety, (reconstruction of one-way roadways, construction of hard shoulders for emergency parking, repair of bridges).

On the federal highways, accident black spots (e.g. curves or hill-crests with overly small radii, junctions and intersections with poor sight distances) are being redesigned step by step. Under the programme for the construction of bypasses, to which approx. 30 % of the funds provided for expansion of the federal trunk road network have been allocated since 1978, it was possible to open 40 bypasses (total length 109.5 km) for traffic in 1996. In total, 1,178 million DM were spent on the construction of bypasses in 1996 alone (1994: 1,076.6 million DM).

In 1996, approximately 54.8 million DM were available from the road construction plan for the elimination of at-grade railway crossings on federal highways as well as for other technical safety measures. These measures were continued in 1997 as well.

Work sites on the federal autobahns are required for maintenance and improvement of the roads (40 % of the federal autobahns in the old Laender are more than 20 years old). In 1996 and 1997 respectively, approximately 700 work sites were present for longer periods (more than 14 days on federal autobahns). The Federal Government co-ordinates such long-term construction measures with the Laender within the scope of the construction planning. The revised "Codes of practice for construction planning on federal autobahns" were introduced in 1996 as a supplement to the "Codes of practice for the safety of work sites on roads" to improve work site management on autobahns. The focal points of this new edition include the avoidance of too many work sites in any particular area of the road network, a new work-site information sign and introduction of a traffic congestion evaluation process. A system providing drivers with information on work-sites on federal autobahns was integrated into the Federal Ministry of Transport's Internet site in 1997. The information on long-term work sites is updated each week.

Traffic-actuated traffic management systems are used to adapt driving speeds to the particular traffic and weather conditions and close lanes for traffic as required. The Federal Ministry of Transport has extended the programme for traffic management systems on autobahns for the period 1996 - 2001 to enlarge the application area of such systems. The length of autobahn sections provided with such systems was approx. 550 km at the end of 1997. By the end of 2001 the length is to be expanded to 1,100 km. Diversion recommendations can be indicated using variable direction signs over a length of approximately 1,400 km of autobahns. By the end of 2001 an additional 700 km are to be equipped with such signs. In 1996 and 1997 the Federal Ministry of Transport allotted a total of approximately 150 million DM to the Laender for the installation of such systems.

Situation-actuated traffic management systems are being installed to an increasing extent on federal highways to make accident black spots less dangerous. The Federal Ministry of Transport invested 13.3 million DM for 17 systems during the report period of 1996 - 1997 which meant that, at the end of 1997, 174 such systems with a total value of approx. 51 million DM were in operation improving traffic safety on federal highways. These include the following types:

- Traffic-actuated traffic signal systems for the improvement of safety at junctions.
- Systems at selected points for traffic or weather-actuated warnings of accident black spots.
- Systems for traffic management with traffic or weather independent control of the traffic at critical road sections.
- Systems for network management for bypassing congested areas.

Since the sixties, passive protective devices (vehicle restraint systems) on roads such as crash barriers, protective concrete walls and impact-reducing casings for crash barriers have served to protect vehicle occupants during road traffic accidents. The guideline upon which the installation of such equipment is based is at present being revised with regard to the future European standards. Crash tests prove that the existing passive protective equipment in Germany has a relatively high safety standard which helps to keep damage resulting from accidents low. Impact-reducing casings for crash barriers improve the safety for motorcyclists and moped riders still further at critical road sections (e.g. in curves).

The Federal Ministry of Transport introduced the revised "Codes of Practice for the Design of Roads, Section on Cross-Sections - RAS-Q 1996 Edition" during the reporting period of 1996 to 1997. There are new developments in this area with regard to cross-sections on autobahns as well as on federal highways. These codes of practice include for the first time a procedure for the specific consideration of traffic safety aspects when several cross-sections are possible options from the point of view of traffic engineering.

Between 1996 and 1997, technical terms of delivery were elaborated for work site safety elements (e.g. traffic barriers, temporary markings and installation devices). The technical requirements relating to the materials and corresponding provisions are included in these terms.

The "Recommendations for Bicycle Traffic Systems - ERA, 1995 Edition" revised by the Road and Traffic Research Association (FGSV) deal mainly with the safe design and operation of bicycle traffic systems. They are harmonised with the new road traffic regulations and the administrative regulations on bicycle traffic.

Responsible motor vehicle drivers are able to assess the majority of road condition characteristics (e.g. slippery due to snow, danger of aquaplaning during heavy rain). However, this does not apply in the case of skid resistance. While the contribution of the roadway to skid resistance remains virtually constant, tyre developments have to be re-evaluated. The technical road construction specifications have been documented in the

"Guidelines Concerning Skid Resistance and Traffic Safety on Wet Roads" by the FGSV in cooperation with the Federal Ministry of Transport. These guidelines are at present being updated. In 1996 the regular recording of the condition of the federal trunk roads was introduced through a General Circular from the Federal Ministry of Transport. In the future safety-relevant characteristics of the condition of the roads such as ruts and skid resistance will be regularly recorded. Damaged points will be recognised and eliminated in time through specific measures.

## European Integration and Road Traffic Regulations

The efforts of individual countries to harmonise their national regulations in connection with European integration are based on the Maastricht Treaty. In Article 75 Paragraph 1 letter c) of the EC Treaty, the European Community is assigned the responsibility for traffic safety, although the so-called "subsidiarity principle" applies. Article 3 b of the agreement states in this regard: "In areas for which it is not solely competent the community shall, in accordance with the subsidiarity principle, take action only in as far as the objectives of the measures in consideration cannot be achieved to a sufficient degree at Member State level and therefore can, due to their scope or their effect, be better achieved at Community level ".

In this context the German Federal Government is of the opinion that all questions regarding behavioural regulations in road traffic can be better and more effectively regulated at a national level than by central regulations which should apply in all Member States but which cannot take into consideration the differences in mentality of the citizens of the individual EU member countries. Rules governing behaviour can be effective when they are linked to the attitudes and patterns of behaviour of those affected; these have developed differently in the various regions of Europe.

At its convention in June 1997 the EC Council of Transport Ministers favourably acknowledged the recommendation of the European Union (EU) to promote traffic safety in the EU (programme 1997 to 2001). The primary objective of this programme is the further reduction of personal injury road accidents in Europe from approx. 45,000 fatalities at present to 25,000 in the year 2010. Public and private measures are to be initiated for this purpose. The following focal points of action are described in the programme:

- further development of the CARE traffic accident data base
- development of an information system on traffic safety measures
- technical and telematic applications for the support of motorised road users
- measures against overfatigue and driving under the influence of alcohol, medication and drugs.

In an ordinance amending road traffic legislation which came into force on 1st September 1997, the Road Traffic Regulations were changed particularly with a view to improving the safety of bicycle traffic (bicycle amendment) and therefore also of promoting the bicycle as an environmentally sound means of transport. In the interest of the safety of child bicyclists, for example, the age limit for riding bicycles on footways was increased from up to 8 years to up to 10 years. Under the Road Traffic Regulations children of up to 10 years of age can now ride their bicycles on footways even when cycleways are present. The previous obligation to use bicycle paths no longer applies to this age group as newer forms - such as cycle lanes- are too dangerous for them. Bicycle roads, to which motor vehicle traffic has access only under certain circumstances, were also included in the Road Traffic Regulations; special bus lanes can be opened for bicycle traffic. The new protective strips are also intended to offer cyclists greater safety. The opening of certain one-way streets for bicycle traffic travelling in the opposite direction, introduced as

a test by order of the Bundesrat, also serves to promote bicycle traffic.

Moreover, the regulations for the use of traffic signs and equipment have been made more exact. The traffic sign density in the Federal Republic of Germany is one of the highest. An excessive number of signs in traffic leads to a general overtaxing and distraction of road users. In order to avoid this in the future, rulings have been drawn up in the Road Traffic Regulations and the associated administrative regulations with the objective of using as few traffic signs as possible and as many as necessary. The target is to remove "unnecessary" traffic signs along public roads.

According to criminal law provisions §§ 315 c and 316 of the Criminal Code, any person who drives a motor vehicle although not in a position to do this in a safe manner as a result of the consumption of alcoholic beverages or other "intoxicating substances" shall be liable to punishment. In contrast to alcohol, there are as yet no threshold values in the case of drugs for assuming absolute driver incapacity. A conviction for driving under the influence of drugs is possible only when driver incapacity can be definitely established and proved. It is frequently difficult to ascertain relative driver incapacity. A regulatory offence similar to the 80mg / 100ml alcohol concentration in blood, which applies regardless of whether driver incapacity has been established, does not exist to date. The Federal Government has closed this loophole in a draft law. Under this draft law, driving a motor vehicle under the influence of certain drugs will be punished as a regulatory offence with a fine and driving ban.

Since 1st July 1991 drivers of certain vehicles for the transport of dangerous goods must participate in special training. This training must be repeated every 3 years. Since 1st January 1997 the same training and testing principles apply in the countries prescribing to the European Agreement Concerning the International Carriage of Dangerous Goods by Road. This standardisation was brought about due to a German initiative and takes into account the courses of training developed in Germany. It is now obligatory for vehicle drivers in all participating countries to prove the knowledge thus obtained by successfully passing a test. Decreasing accident figures for vehicles carrying dangerous goods indicate that such training has been a success.

Since 1st October 1991 it has been obligatory to appoint dangerous goods advisors in all transport companies which deal with the carriage of dangerous goods. They supervise observation of the regulations governing the transport of dangerous goods in their companies. Within the scope of training programmes they obtain the required knowledge of their obligations and the safety aspects of international regulations for the transport of dangerous goods. This safety concept has led to a decrease in the number of accidents in the carriage of dangerous goods resulting from failure to observe the safety regulations.

The positive experiences in Germany have led to a comparable regulation being passed for the territory of the European Union regarding the appointment of safety supervisors for the transport of dangerous goods by road, rail or inland waterways. The scheduled date for this Directive to become effective in the countries of the European Union is 1st January 2000. In Germany the more than 30,000 dangerous goods advisors are being elevated to the status of EU safety supervisors by an amendment to the Ordinance on the Appointment of Dangerous Goods Advisors. Within the scope of the European Agreement Concerning the International Carriage of Dangerous Goods by Road , a general obligation of companies to train persons involved is to become effective on 1st January 1999.

With the exception of the ruling on immediate measures, the EC Directive on the Approximation of the Laws of Member States with regard to the Transport of Dangerous Goods by Road was implemented on 1 January through the Ordinance on the Transport of Dangerous Goods by Road and the Ordinance on

Exemptions from the Dangerous Goods Regulations; with the exception of the passages governing official aid, the EC Directive on Uniform Procedures for Checks on the Transport of Dangerous Goods was implemented on the same date through the Ordinance on Checks on the Transport of Dangerous Goods by Road and within Undertakings. In all Member States a representative number of dangerous goods transports are now to be checked according to standardised testing criteria. The road checks are to be supplemented by checks in the companies.

**Automobile Engineering**

As explained at the 15th ESV Conference in 1996 a significant contribution to motor vehicle safety and environmental protection is being made in the field of design and efficiency regulations for motor vehicles through the adoption of international regulations into national law as well as through further definition of the remaining latitude in national regulations. This relates firstly to the work as a member of the UN Economic Commission for Europe (ECE) which has passed a total of more than 100 Regulations with standardised provisions for motor vehicles, their trailers and associated components, the contents of which largely correspond with EC Directives. Over 80 ECE Regulations apply in Germany. Secondly this concerns the work as a Member State of the European Union (EU) to harmonise automobile engineering regulations for vehicles intended for transporting passengers and goods as well as farm and forest vehicles, motorcycles and associated components.

Step by step, national regulations currently in force are being revised to incorporate EC Directives.

Regular technical inspection of vehicles in the EU is ordered in an EC Directive. This prescribes the intervals at which inspections on buses, taxis, ambulances, cars and commercial vehicles take place. Germany suggested that motorcycles, caravanettes and caravans should be included in these inspections, which are to apply in all EU countries. The German Federal Government is also making urgent efforts in EU consultations to bring about a more precise definition of the scope of such technical inspections and the inclusion of clear inspection criteria and a test for heavy vehicles, which is at least comparable to the German special brake test or the new safety inspection.

The national and international laws regarding environmental protection and the active safety of motor vehicles have become more stringent during the last few years. In order to fulfil the environmental requirements of EURO I for cars, manufacturers were called upon to use state-of-the-art technology. In the case of diesel vehicles, the main area of improvement was the engine combustion system; in the case of petrol vehicles, emissions were purified using regulated catalytic converters (G-Kat). The German Federal Government provided tax concessions for vehicles with the regulated catalytic converters even before EURO I came into force (1993) which has resulted since then in a stark reduction in the quantity of classic pollutants such as CO, HC, NOx, lead and benzene despite an increase in total travel. There will be a recognisable reduction in the particles as the percentage of EURO I and especially EURO II cars (mandatory for trucks as of 1996, for cars as of 1997) increases.

In terms of passive vehicle safety, particularly crash behaviour during accidents, an EC Directive and an ECE Regulation exist on the behaviour of steering systems in passenger cars during head-on collisions. Although it has not been mandatory for EU Member Countries to apply these international regulations to date, German motor vehicle manufacturers perform crash tests on their passenger cars in order to continuously improve passenger protection.

At international level the Federal Republic of Germany collaborated with other Member States to pass two ECE Regulations concerning head-on and side collisions in passenger cars; Regulations No. 94 (head-on collisions) and No. 95 (side collisions) could be applied

from 1995 and 1996 respectively. At EC level, the Council and the European Parliament passed the Directives on side and head-on collisions with more stringent requirements in 1996; these will become obligatory as of October 1998 for all new passenger car models.

The Federal Republic of Germany is participating in the increased world-wide efforts to harmonise regulations. With regard to the introduction of the Directive on side collisions the automobile industry is making even greater efforts to further increase passive motor vehicle safety.

## Accident Statistics

There are differences in the accident development of the area of the Federal Republic of Germany before 3rd October 1990 and the area of the five new Laender. For this reason they are considered separately in the following.

In the old Laender, the number of road traffic accidents decreased by approximately 2.7 % between 1994 and 1997 to approx. 1.7 million. In contrast, total travel rose by 3.3 %.

The number of traffic fatalities has decreased since 1970 by more than two thirds; during the same period, the number of motor vehicles rose from 17 million to 41 million and total travel increased by 119 %.

Not including the new Laender and Berlin (east), there were 6800 traffic fatalities in 1994, 6,525 in 1995 and 6,126 in 1996; in 1997 there was the lowest number of fatalities since 1953 at approx. 6,000 fatalities. In 1994 3,970 car occupants died, in 1996 the number of car occupants killed decreased to 3,801.

Following German reunification in October 1990, the accident statistics in the five new Laender must be considered separately: in this region, 3,014 fatalities were recorded in 1994, 2,928 in 1995 and 2,632 in 1996; in 1997 the number of fatalities decreased to approx. 2,500.

## Accident Research

As at the previous conferences this section includes the activities of the German Federal Government, the automobile industry and the automobile insurance companies.

The Federal Ministry of Education, Science, Research and Technology has been sponsoring research and development projects to improve active and passive safety in motor vehicle traffic for many years.

In the past, the transportation of dangerous goods by road was a particular focal point of sponsorship. In this context reports were presented at the past ESV conferences on the development of the safety tanker trailer TOPAS as well as on the results of the THESEUS project (tank vehicles with maximum achievable safety through experimental accident simulation).

In the recent past a significant contribution to the improvement of active safety of road traffic has been made by fundamental research into and development of telematic systems for traffic. With the development and testing of modern data capture systems and of communication, guidance and information technologies, deficits in traffic management and on the part of road users in terms of up-to-date and complete information can be reduced. This will in future allow critical traffic situations to be recognised as they occur which will significantly reduce the risk of accident. In this context the Federal Ministry of Education, Science, Research and Technology sponsored the EUREKA project PROMETHEUS and the BEVEI project (better traffic information) with a total outlay of approx. 140 million DM. Numerous safety-relevant systems from research projects mentioned have already produced promising results in tests in demonstration vehicles.

The German Federal Government`s current research framework, which was published in 1996 under the title: "Benchmark Figures for a Future-Orientated Mobility Research Policy" has the motto "maintaining mobility long-term while significantly reducing the undesired consequences of motor vehicle traffic". Improvement of traffic safety is one of the five main fields of research sponsorship. In the project network "Safe Roads" started by the Federal Ministry of Education, Science, Research and Technology in this regard the focal point will continue to be the improvement of active safety.

Under the title "MOTIV" - Mobility and Transport in Intermodular Traffic", the German automobile and electronics industry and traffic service providers have started a wide-ranging combined project sponsored by the government which has as primary objectives the improvement of mobility in conurbations and the increase of traffic safety. MOTIV builds on the results of the PROMETHEUS project which has been discontinued; in contrast to the research in the past which dealt more with fundamentals, MOTIV is orientated rather towards quick implementation - at European level as well.

In the subprojects of the combined project "MOTIV" which are part of the project network "Safe Roads", systems for increasing traffic safety and traffic flow are being developed. These include systems which provide effective support for drivers in selecting speed and vehicle-to-vehicle distance when travelling behind a vehicle up until the time when the vehicle in front stops, for warning drivers of potential traffic conflicts with other road users when changing lanes or turning and for reducing the conflict potential through active intervention. As it is still necessary to clarify basic questions of technical feasibility and find economically viable solutions, decisions regarding the further realisation of these systems will be made only after the feasibility studies have been completed.

Moreover, legal and ergonomic aspects of the various degrees of automation of vehicle guidance functions will also be subjected to in-depth analysis in subprojects related to this subject in order to obtain information on the possibilities and limits of automation for such tasks.

In addition to the activities in MOTIV, other projects in the project network "Safe Roads", which are intended to supplement the work for improving active safety which is already in progress, are currently being approved.

One of the focal points of these projects, which will start in the near future, is better recognition and protection of vulnerable road users including investigations into how such road users can contribute most economically to their own protection. Another focal point is the investigation of how assistance systems can support drivers in an optimum manner and particularly how over-taxation and under-taxation can be avoided in this respect, how protection against rear-end collisions can be improved through warning the traffic behind sufficiently early and how protection of young road users of pre-school and primary school age can be improved through new approaches to traffic education.

The Federal Minister of Transport has continued his comprehensive research efforts; the Federal Highway Research Institute is involved to a significant extent in this work. The following will deal for the main part with the automobile engineering projects only.

As stated at the 15$^{th}$ ESV Conference, at-the-scene accident investigations have been continued. Each year, approx. 1000 accidents are recorded in detail and evaluated. At present a comprehensive data base exists containing the details of 14,000 accidents involving 20,000 injured persons; 24,000 vehicles are documented and there is information on 80,000 separate injuries. These data have been used in a variety of ways, inter alia for European projects on protection in head-on and side collisions and the EEVC`s work on pedestrian safety. These local accident statistics are incorporated into the commission`s 4$^{th}$ research project related to child

restraint systems, motorcycle helmet development and the standardisation of accident investigations. At present negotiations concerning the extension of these investigations are in progress with the German automobile industry.

Studies on child safety in passenger cars showed that in practice two out of three child restraint systems are used incorrectly in such a way that their effect is reduced. The main reasons for this were insufficient knowledge on the part the parents and incorrect assumptions regarding the correct method of securing children. Technical deficits were also established. From the results of the study it was possible to derive approx. 60 individual recommendations, which are directed to manufacturers of child protection systems, automobile manufacturers, the legislator and standardisation committees just as much as to the users of such systems - children and parents.

In Europe, child restraint systems are subjected to head-on collision tests in accordance with ECE Regulation 44. To date, side collisions have not been accounted for in the Regulations. The BASt is involved in the development of a new generation of child dummies which can be used for head-on and side collision tests. Parallel to this, the research group CREST (Child Restraint Systems for Cars) which is sponsored by the European Commission, has been founded with the participation of the BASt.

Various aid organisations offer transport services to wheelchair users. Transport vehicles for disabled persons, in which the disabled persons can remain seated in their wheelchairs during the journey, are used for this purpose. Crash tests performed by the BASt showed that commercially available safety and restraint systems were complicated to operate and did not provide a sufficient level of safety. The restraint system which has now been developed by the BASt enables disabled persons to be transported safely, consequently improving their ability to participate in social life. The system forms the basis for a revision of the technical provisions (DIN standard 75 078 part 2 "Restraint Systems for Transport Vehicles for Disabled Persons").

Crash tests carried out as part of the project "Safety of Vehicle Trailers for Child Transportation" indicated weak points in bicycle trailers for child transport. Test procedures for evaluating the safety of bicycle trailers have been developed with the objective of establishing a DIN standard.

Buses not used in city traffic and which do not have standing room for passengers will in future be equipped with seatbelts; this is prescribed by an EC Directive. Under this Directive, buses with a permissible gross weight of up to 3.5 t must be equipped with three-point seatbelts and buses with a gross weight of more than 3.5 t with lap belts. Certain child restraint systems, particularly those intended for children of up to 9 months and from 6 years to 12 years of age cannot be utilised correctly with lap belts alone. The BASt drew up recommendations for technical improvements.

The parts of the studies for revision of the legal requirements in side collisions which relate to head impact in the interior of the vehicle have not yet been completed. Head injuries to car occupants occur particularly frequently during side collisions. For the continued practical application of the side collision tests elaborated by the EEVC, they are being further developed along the lines of the test procedure already prescribed in the USA.

Airbags are increasingly becoming part of the standard equipment in passenger cars. The project "The Protective Effect of Airbags in Particular Sitting Positions (Out-of-Position)" studied the limits of the airbag effect in different sitting positions. During the crash test with an airbag system widely used in Germany no significant increase in the accident risk for vehicle passengers and passengers positioned close to the steering wheel was noted. The interaction of three-point seatbelts, safety belt tensioners and airbags provides a high overall level of safety for the driver.

Severe accidents resulting from the effect of airbags, as reported recently in the USA, can be excluded for Europe. The reason for this is that a general obligation to wear seatbelts has to date not been brought into force in the USA. The airbags must therefore be designed for passengers not wearing seatbelts and inflate to a large volume very quickly in the event of an accident. In contrast, due to the high "buckle-up quota" in Europe, airbags are designed as a supplementary restraint system to avoid impact between the head and components of the vehicle interior. The low volume allows it to be inflated more slowly and therefore less aggressively. The risk of injury is consequently reduced in "out-of-position" cases.

To provide consumers with objective information on passive safety in vehicles, the evaluation procedure TUB-NCAP was elaborated after many years of research and validated in real accidents by an international research association. The TUB-NCAP procedure is based on accident analysis and statistical biomechanics. The degree of fulfilment of the protection criteria is determined for the test results from various crash tests and the variables weighted in this manner are brought together in an overall safety index using a relevance structure which reflects the significance of the injuries to the various parts of the body during real accidents. The German Federal Government is attempting to realise a "EURO-NCAP" orientated towards real accident occurrences on the basis of this work.

An FE model of the human head was constructed in a co-operative project involving the Technical University of Berlin and the Institute for Forensic Medicine at the University of Heidelberg. The University of Heidelberg determined the different strength values of the various bones in the human skull. A detailed replica of the skull was completed using computer-tomographic diagrams. The ability of this model to simulate injury mechanisms during impact from a blunt instrument was validated in tests with cadavers.

A major German motorcycle manufacturer has developed a two-wheeler concept, in which the driver is secured by a belt system in a so-called protective zone. This vehicle has been examined by the BASt with regard to an exemption from the obligation to wear a helmet and with regard to active and passive safety. In the opinion of the BASt the two-wheeler tested is as safe to drive as a commercial motorcycle for a rider with a helmet. The BASt therefore recommends a provisional exemption from the obligation to wear a helmet.

Together with representatives of industry, "Guidelines for the Design and Installation of Information and Communication Systems in Motor Vehicles" have been elaborated for the safe utilisation of technical equipment in motor vehicles for information and communication purposes such as on-board computers, navigation systems, car phones, etc. This is a pilot agreement for the German position in national and international standardisation committees (DIN, CEN, ISO). Studies on telephoning at the wheel and the operation of vehicle spacing control systems also relate to this area. Further studies are carried out within the scope of research programmes by German industry and world-wide research programmes on "Intelligent Transportation Systems (ITS)".

In March 1998 a workshop took place at BASt at the request of the Federal Ministry of Transport, which dealt with a comparison of the present state-of-the-art in Germany and other countries, with current research activities and development projects as well as with the prospects of telematic technologies and driver assistance systems in motor vehicles for the improvement of traffic safety. Experts from industry, research and politics were given the opportunity to exchange views on and discuss four main subjects: German and international activities, the current position in research regarding driver assistance systems, opportunities and risks as well as problems for market introduction. At the conclusion of the workshop there was a podium discussion in which the main subjects were treated with regard to fields of activity for the private economy and public institutions.

An international workshop on the same subject with participation of experts from the Netherlands and Great Britain is planned for a later date.

BASt is participating in the international activities of the IHRA related concerning the subject of ITS on behalf of the Federal Ministry of Transport. An initial step was the completion of a survey, in which 17 research projects on the topic of human/machine interface were evaluated by Germany.

A committee of experts in Brussels is dealing with questions regarding the possibilities of implementing "Telematics in the Transport Sector". Fields of action are being differentiated according to public and private interests. Another committee is concerned with questions relevant to safety in connection with the introduction of new technologies in motor vehicles, e.g. how far can and should technical equipment intervene in the personal responsibilities of the driver? Should new technologies for improving traffic safety be introduced on a mandatory or voluntary basis?

Pilot projects on technical equipment in motor vehicles are the focal point of the common activities of EU Member States. Under the overall control of the Netherlands, tests are being carried out on an intelligent speed controller (ISA - Intelligent Speed Adapter), which serves to select speed according to the situation via road controls.

The BASt is currently having tests carried out on the safety aspects of driver assistance systems such as Systems for Controlling Driving Dynamics and Systems for the Automatic Driving of Motor Vehicles. For this purpose the dynamic driving potential of the model for regulating driving dynamics was investigated in a simulated test and error simulations carried out. Using this electronic system with automatic regulation of the vehicle brake system as an example, the procedure for safe design of mechatronic systems was discussed and the basic approach to risk analysis presented. Recommendations for necessary regulations in terms of the approval and technical supervision of such systems, taking into consideration national and international laws, are being derived by the researchers. These concern general requirements for electronic systems as well as special requirements for the brake systems in motor vehicles. Systems for automatic driving will be examined in a study being started at present on legal and traffic safety and safety with regard to interaction and the system itself. Based on consultations with experts and technical simulation studies, recommendations are to be derived for legal regulations and technical standards.

Since no clear figures are available to date on failure frequencies and the scope of failures in electronic systems in motor vehicles relevant to safety or the environment, a random study was performed on electronic systems (ALS, airbags, engine and transmission control). For this purpose readings were taken of the fault memory in the systems in order to determine the scope of the defects which occurred and to estimate the effects.

The results of the research project were the subject of a discussion of experts. The conclusion derived from the results regarding the necessity of regularly checking electronic systems in motor vehicles proved, however, to be controversial. More discussion of this is required. The participating experts agreed that, in a current suggestion for a Directive made by Germany, which is being discussed at present in Brussels and Geneva, a suitable type approval regulation had been reached which takes into account the future technical inspection of these systems.

The dynamic behaviour of motor vehicles is a significant aspect of active safety. Evaluation of this behaviour is difficult, because the overall system is characterised by the interaction of the driver, vehicle and environment and each element is already complex in itself. The objective of a research project carried out by the BASt was to examine the interrelationship of subjective driver perceptions and objectively measurable variables which characterise the handling of a passenger

car. So-called open-loop and closed-loop driving tests were performed with the same vehicle; the handling characteristics were, however, changed by modifying the vehicle parameters. The test drivers consisted of 40 "normal drivers" and 12 "professional drivers", who evaluated the driving characteristics on the basis of a prescribed evaluation method. It was possible to ascertain that the subjective evaluation best correlated with the time delays between steering wheel angle and yaw velocity and between steering wheel angle and lateral acceleration as well as with the sideslip angle. The roll velocity also had an effect on the driver's evaluation. Although the validity of the interrelationships found was proved for the investigated vehicle versions and driving situations, further studies on other vehicles and in other situations are required to discover whether the results apply generally.

The primary benefit of the accident data recorder (ADR) is its contribution to clarifying the causes of traffic accidents. A research project commissioned by the BASt investigated whether further benefits for accident research in the form of analysis of the chronological events immediately before a collision (pre-crash phase) are possible with such instruments. It was seen that the ADR always provides objective data independent of the road condition or activation of ALS and that it can increase the degree of information obtained for individual characteristics (such as braking and/or steering reactions of the driver before an accident). This allows a more precise analysis of motions and events in the pre-crash phase even when the use of conventional reconstruction procedures provides no or insufficient information. Overall, the use of ADR in combination with conventional accident analysis procedures can improve the reliability of data records and the gains in knowledge for accident research.

In the Federal Republic of Germany the maximum permissible speed for passenger cars with trailers is limited to 80 km/h. In view of the fact that there are a large number of car-trailer combinations which demonstrate safe handling characteristics at higher speeds and also that higher speeds are permissible in other countries, the BASt investigated within the scope of two discussions of experts whether the speed limit for passenger cars with trailers could be increased from 80km/h to 100km/h on autobahns and which aspects have to be taken into consideration in this context. A corresponding major test is planned in the course of further considerations.

Due to the findings of the two discussions of experts a paper has been drafted by the BASt containing a concrete suggestion regarding the obtaining of a temporary special permit for car-trailer combinations allowing them to drive at a maximum speed of 100 km/h on federal trunk roads (including a certification sample required for this purpose).

According to the German Traffic Regulations (StVO) the speed limit for motorcycles with trailers on roads outside built-up areas (including autobahns) is 60 km/h. On account of a discussion of experts at the BASt, an increase in the present speed limit of 60 km/h is recommended for motorcycles with single-axle trailers, even though some questions remain open regarding the driving dynamics for such vehicle combinations at higher speeds. To date, however, no information is available on what the upper limits are, to which the permissible speed for all motorcycles with trailers could be raised without risk regarding driving dynamics.

By contract to the BASt, a research project for the improvement of bicycle traffic safety was carried out in 1995, in which, inter alia, the question as to which strength requirements should be made for parts of bicycles relevant to safety was considered. The results of this study - which are also to be incorporated into the corresponding German Standard (DIN 79100) - were the subject of a subsequent discussion of experts. It was seen in this regard that the strength test requirements for bicycles planned for the German Standards were insufficient. The experts recommended determining the operating loads for a number of representative bicycle models. A corresponding study was carried out by

contract to the BASt in 1996 - 1997. The effective operating loads of a total of 17 bicycles were determined on bicycle paths, paved roads and on rough roads. Supplementary to this, special occurrences (emergency braking manoeuvres, minor falls) and misuse (overloading, driving over potholes and curbs) were also taken into consideration. The loads determined in this more recent study provide a good basis for drawing up strength requirements and test conditions for the structurally durable design of bicycles and bicycle parts.

Defective shock absorbers can change the driving behaviour of motor vehicles. For this reason technical inspection of shock absorbers is part of the main safety inspection required under Sec. 29 of the Motor Vehicle Construction and Use Regulations. Various parties have requested that this visual test is supplemented by an objective testing method. In a number of studies the frequency of defective shock absorbers as well as their role in the occurrence of accidents was therefore estimated. Moreover, the BASt also held two discussions of experts on this subject. The results gained so far must still be verified.

Retreaded passenger car tyres account for 2 % of summer tyre sales in Germany and for 11 % of winter tyre sales. The retreading process offers an active contribution to environmental protection and conserves resources. A recommendation by the EU Commission provides for the prohibition of the disposal of old tyres as waste from the year 2000; the significance of retreading tyres is therefore growing. It must be ensured that no safety deficits result from the use of retreaded tyres in countries such as Germany where there are no speed limits on the autobahns. Uniform standards for retreading are being discussed in the ECE. The BASt has studied the influence of carcass age, repair of punctures and classification of the permissible speed for retreaded tyres in 180 tests.

The age of the carcasses to be used should not exceed 6 years. Repairs should be regarded critically and reclassification in a lower speed class is recommended. It also appears problematic to allow a maximum speed of 240 km/h for retreaded tyres.

The research efforts regarding the efficacy analysis of exhaust tests on diesel vehicles and passenger cars with regulated catalytic converters reported at the last ESV Conference are being continued. Final results are expected in the coming year.

Within the scope of the research project "The Effects on Traffic and the Ecology of Overtaking Prohibitions for Trucks on Autobahns", the effects on traffic safety inter alia were studied. An analysis of the accidents in a before/after comparison was made on three autobahns with one-way roadways amounting to a length of 430 kilometres; approx. 10,600 accidents were evaluated. It was not possible to establish any fundamental effects on traffic safety resulting from an overtaking prohibition for trucks. The following conclusions appear justified: the overtaking prohibition for trucks can be expected to have a favourable effect on traffic safety, particularly under certain framework conditions, inter alia when the involvement of trucks in accidents is significantly higher than their percentage in traffic, when a steep slope is present or when the sections in questions are preceded by a reduction in the number of lanes. There are indications that a limitation of the length of the section in which overtaking is prohibited to approx. 10 kilometres is also favourable from the point of view of traffic safety.

The German automobile industry is increasing its work on developing innovative lighting systems as a further contribution to improving active vehicle safety.

BASt performed studies on pollutant emissions and fuel economy when the engine is shut off for a short time and investigated how long the engine has to remain shut off compared with an idling engine to compensate for the increased pollutant emission and fuel consumption which occur during the starting of a motor. The study showed that the minimum shut-off times for advantages to be gained from the temporary shut-off differ for the various

exhaust constituents and fuel economy. For the BASt's emission test vehicle the times were several minutes in the case of hydrocarbons with the exception of carbon monoxide, only a few seconds for nitric oxides and approx. 10 seconds for the fuel economy. No tests were performed under actual traffic situations. The results were obtained exclusively using the emissions test vehicle with a warm engine and without erroneous operation such as depressing the throttle while starting the engine. The applicability of these conclusions to other vehicles - particularly vehicles with other engine, mixture generation and emission control concepts - is therefore only permissible to a limited extent if at all. It can be assumed, however, that the order of magnitude of the results applies to comparable vehicles equipped with catalytic converters.

During the past few years the rescue services in the Federal Republic of Germany have become a nationally and internationally acknowledged system.

According to continuous projections the rescue services had 9 million assignments in 1996/1997; of these, 60 % consisted of ambulance transports (urgent and non-urgent) and 40% rescue operations (with and without emergency physician). This means that, on average, every 9$^{th}$ resident used the rescue services once a year. The number of rescue operations accompanied by an emergency physician is increasing continuously: in 1985, 32 % of the rescue operations were accompanied by a physician; 12 years later the figure was 48 %. The response time, i.e. the period of time between the reporting of the emergency and the arrival of the rescue vehicle at the accident site was on average 7.7 minutes.

Approx. every 11$^{th}$ emergency assignment (9 %) involved a traffic accident. The percentage of the total number of emergency assignments made up by traffic accidents has decreased continuously during the course of the years. 20 years ago it was still 27.2 %.

The German Insurance Association has systematically enlarged its databases on personal injury road accidents during its accident research which is carried out by the Institute for Vehicle Safety.

Based on a previous evaluation of 15,000 car-car crashes, approximately 1,000 accidents with seriously injured occupants were evaluated. The data are now in a database which is accessible for accident investigations and have been comprehensively analysed. It could be seen that future developments in the field of safety must be designed to take greater account of angular head-on collisions and the protection of elderly persons. The optimisation of side protection and foot space in cars must be taken into consideration in the development of vehicles.

The evaluation of approximately 1,200 pedestrian accidents has now been completed. Material solely on collisions between pedestrians and cars constructed in 1996 or later is at present being compiled to supplement this investigation. The objective is to be able to quantify the influence of new automobile body shapes on the accident sequence and origin of accidents.

The German Insurance Association research study "Improvement of the Protection of Children in Cars" was completed under contract to BASt. It was seen that, despite considerable improvements in child protection systems, there are still deficits, above all in their operation and use by parents. Misuse of child seats (incorrect installation of seat, incorrect securing of the child in the seat) was ascertained in two-thirds of the cases examined. Questioning of 150 test persons revealed that the rate of incorrect operation (between 60% and 80% in the case of conventional systems) could be reduced to approximately 4% through the introduction of ISOFIX.

In the ISO work group for the development of a Test Standard for child seats, various child seats were for the first time tested in side collisions.

The continued investigation of airbag accidents has shown that the problems regarding rear-facing child seats

and out-of-position front seat occupants can be solved to a large extent using an "intelligent airbag". It was also established that raising the actuation threshold of the airbag to 25-30km/h would on the one hand lessen the injuries caused by the airbags (grazes, 1st degree burns) and on the other lower the costs caused by an unnecessary release of the airbag; the protection of the car occupants would at the same time not be reduced.

Under the EU research project "Whiplash", the following three topic areas were dealt with:

- 500 rear end collisions were evaluated medically and technically. It was confirmed that a high percentage of the slight cervical vertebrae injuries which occur at low collision speeds cannot be explained biomechanically;

- particularly well-documented cases were reconstructed in detail, in order that they could be repeated in crash tests;

- sled tests with volunteers were supposed to provide new information of the kinematics of vehicle occupants in rear-end collisions, in order to better understand the biomechanics of such injuries and to validate future cervical verterbrae dummies.

In the field of motorcycle safety, the crisis situations leading to crashes were investigated in 500 collisions between motorcycles and cars. The findings from the study were incorporated into a leaflet for motorcycle riders and a video film which is made available to interested persons.

The focal point of the work in commercial vehicle accident research was the improvement of rear underride protection. In addition to this a study was drawn up on the origin of accidents involving unprotected road users which occurred while commercial vehicles were turning; this study showed that a considerable number of such collisions could be avoided through electronic aid devices for heavy vehicle drivers.

You will find the contributions of the German car industry in the various technical seminars at this conference.

We will follow the talks given over the next few days with great interest. We would like to express our wishes that this year`s ESV conference is a complete success.

# The European Enhanced Vehicle-Safety Committee (EEVC)

**Bernd Friedel**
Bundesanstalt für StraBenwesen

It is again my pleasure to present the Status Report for the EEVC and to describe the work we have done since the last conference. One important step was the change of the name of our committee. According to the shift of the focus of the ESV conferences from concentration on the development of experimental safety vehicles to broader issues of motor vehicle safety there was since years a parallel shift in the work of EEVC. The new name European Enhanced Vehicle-Safety Committee reflects this change and keeps the acronym EEVC.

## Frontal Collision

The Working Group 16 was created with the tasks of continuing the support and development of the EEVC offset deformable frontal impact test procedures and also to provide the real point for the European contributions to the work of the International Harmonized Research Activities (IHRA) Working Group on Advanced Offset Frontal Testing. The terms of reference were formulated in the beginning of 1997. One of EEVC's obligations to the EC was the finalisation of the foot certification procedure. This task has been completed and the EEVC recommended certification procedure comprises impacts with a defined pendulum to the toe and to the heel without shoe together with a further impact to the heel fitted with the specified shoe.

Other tasks to be considered in relation to the EC directive of frontal impact are the evaluation of the potential benefits of an increased speed and the potential benefits of an extension of the scope of the directive to N1 vehicles and M1 vehicles between 2.5 and 3.5 tonnes. In addition, the accident analyses may provide information for the footwell intrusion measurements.

This EEVC working group is also considering future developments of revised barrier faces and a methodology for the evaluation of barrier faces. As part of the contribution to the IHRA work, WG 16 is considering the relative merits of a mobile barrier test procedure.

## Side Collision

The work is continued to develop a repeatable and meaningful head impact test procedure. A paper on this work will be presented at this conference in which the relative benefits of free flight and linear guided impacts are investigated. The provision of airbags in the head impact zone in some cars is being taken into account by the working group as there is no wish to discourage innovative and potentially beneficial safety measures from being introduced.

The work of Working Group 13 was also addressed to the development of test methods for evaluating and comparing the performance of different existing side impact barrier faces. In a second paper the results of this comparison will be presented during this conference.

In a second paper, the development of these test procedures and some pilot study results will be presented. Previous experience has shown that different designs of barrier face can give different results in full scale test impacts. The tests being developed are intended to be able to evaluate different designs under realistic conditions. A full test programme in which the performance of seven different barrier designs has been planned for the coming year.

With regard to the EU Directive 96/27/EC on side impact protection the working group will evaluate the potential benefits of an increased test speed and the need to change the mobile deformable barrier face height and/or ground clearance. In addition EEVC will also review the need for a pole side impact test. The initial approach to these topics will be an analysis of accident data bases in conjunction with a review of current test experience.

## Compatibility

The EC Commission is funding the studies of this working group through a larger research project. The project has started in the middle of 1997; the running period will be two years.

This project will provide for the start of a scientific approach to the question of compatibility. At the beginning, effort will be concentrated on the most important impact types: passenger car to car frontal and side impacts. During this work, consideration will be given to the implications for pedestrian and other types of impact but they will not be directly addressed.

The work will cover three main activities:

- Data from in depth accident studies will be used to

identify the most important problems related to compatibility.

- Typical accident configurations will be replicated by carrying out experimental car to car impacts. These crash tests should help to identify the major problems occurring when two cars impact.
- Computer simulation modelling will be used to study the effects of changing the effective stiffness and mass of two cars impacting.

Vehicle incompatibilities can be observed in vehicle structure (stiffness and geometry) and vehicle mass.

Up to now mass incompatibility has been identified and quantified in a large number of studies. One task of the compatibility project should be to come to a better description of the effects and better established figures concerning the quantification of this effect. The most successful method in this field seems to be the analysis of overall accident statistics for vehicle groups of similar structure. A comprehensive structural survey for passenger cars shall help to define those vehicle groups of comparable vehicle structure.

About the results so far achieved a detailed report will be given at this conference.

Beside this programme the Working Group 15 provides scientific input to the IHRA working group on the same topic. A cooperation with a BRITE-EURAM project in the same field is established.

**Dummy Development**

Working Group 12 was originally created with respect to the development of frontal impact dummies. The terms of reference are now enlarged to achieve the development of universally acceptable advanced anthropometric adult crash dummies for various impact directions. Secondly, with this working group the EEVC contribution to the IHRA international working group on Biomechanics is assured.

The frontal impact dummy activities of WG 12 are carried out through the EC funded ADRIA consortium. Main activity is the evaluation of the advanced frontal impact dummy THOR developed in the United States. The evaluation results will be reported to EEVC WG 12. Results will be available in the summer of 1998.

Concerning the initiative of ISO for the development of a Harmonised Side Impact Dummy, EEVC proposes to NHTSA that IHRA should take the lead in such a project. The work to be carried out should include review of existing biomechanical data, desirable features based on current dummy experience, revision of existing test devices against these biomechanical data and desirable features, and the latest information on injury tolerances.

In Europe recently the so-called SID-2000 consortium was established, dealing with future side impact dummy development activities. The work in this consortium is funded by grant from the EC within the so-called BRITE-EURAM program. The consortium will enhance side impact dummies for improved occupant protection beyond the year 2000. EEVC was informed that results of this European SID 2000 will be made an integral part of the ISO Harmonised Side Impact dummy developments.

**Pedestrian Protection**

Working Group 17 Pedestrian Safety was established in 1997, with the tasks to:

- Review the EEVC WG 10 test methods published 4 years ago and propose possible adjustments taking into account new existing data in the field of accident statistics, biomechanics and test results
- Prepare the EEVC contribution to the IHRA Working Group on pedestrian protection.

The EEVC WG 10 test methods consist of sub-system tests to the bumper, bonnet leading edge and bonnet top. Concerning the first task of WG 17 accident data were analysed dealing with bonnet leading edge injuries. The UK data show a shift from upper to lower leg injuries, but upper leg including pelvis injuries are still frequently seen. The German data show a decrease in the percentage of injuries caused by the bonnet leading edge. This is confirmed by a French study. Looking to pedestrian injuries in accidents with a car impact speed up to 40 km/h, it was found that the bumper is the most important car area, followed by the bonnet top and finally the bonnet leading edge. Based on these accident figures, the bonnet leading edge test method is reviewed in order to define a better relation between modern car shapes and subsystem test conditions. A series of accident reconstructions will be done to investigate the appropriate acceptance level for the bonnet leading edge test requirements.

The feasibility of the test methods is studied also for vehicles with extreme dimensions, like 4x4 off-road vehicles.

The impactors used for the sub-system tests have been improved, however without fundamental changes to the design principle.

The European input to the IHRA activity on pedestrian protection was mainly focusing on accident statistics.

**Underrun Protection of Heavy Goods Vehicles**

During the last ESV conference the results of Working Group 14 were reported. A proposal for further funding by the EC commission was unfortunately not successful. The high priority for further development was underlined to the High Level Group on Traffic Safety at the end of 1997. Further decision-making of that Group is expected for March 1998.

The work so far achieved was presented at the SAE TOPTEC Conference about Heavy Vehicle Underride in April 1997 and was well received.

Our intention is to extend a closer cooperation on this issue with the USA and Australia.

At the end of 1997 the main committee of EEVC decided to enlarge the terms of reference of this working group also to deal with the necessary research to improve existing regulation on rear underrun protection.

**International Cooperation**

EEVC has continued the links of cooperation with the EC and the ECE. The steering committee has noted interest in the EC paper on "Promoting Road Safety in the EU Programme for 1997 - 2001". For the 5th RTD framework we have proposed research activities on the following issues:

- downsizing and compatibility
- biomechanics
- vulnerable road users
- evolution of frontal and side impact beyond October 1998

The scientific contributions of the European community to the international harmonised research activities within IHRA are being made through the EEVC. In particular, the EEVC is actively contributing to the work on frontal protection, compatibility, dummy development and pedestrian protection as has already been mentioned.

Our scientific knowledge is continuously transferred to the ECE in Geneva, particular items are front and side impact, interior head protection, and improvement of front underrun protection for trucks.

We are well prepared to continue our international cooperation, not only in Europe, but also with North America, Japan and Australia. The exchange of scientific knowledge is a solid fundation for improving existing regulations.

**Outlook**

The new name European Enhanced Vehicle-Safety Committee should be understood as our firm involvement in all questions relating to vehicle safety. We are convinced that developing technologies offer new possibilities for improving the safety of road vehicles.

We confirm our willingness to continue to cooperate internationally including our active participation in the ESV conferences.

# France

**Jean-Pierre Médevielle**
French National Institute for Research in Transportation and Safety

## INTRODUCTION

This report, as the last one, covers the road safety activities concerning France, and in particular these having repercussions on the safety of vehicles for these last years.

On this subject, we have to remind that even if the national level keeps a wide autonomy of decision, now we can not conceive it without a range of decisions places or preparation of decisions at an European, international level but also at a local level.

### I. The progression of road safety in France

Since the last ESV Conference, figures show obviously an amelioration on the important datas, but the public authorities and all this field actors keep being worried if we compare our results, with all the usual precautions, to other countries, and particularly European ones.

The number of dead within 6 days* is fallen below the 8 000 deaths (7 987 in 1997, 8 412 in 1995) ; likewise for serious injuries (35 716 in 1997, 39 257 in 1995), slight injuries (133 742 in 1997, 142 146 in 1995) or casualties (125 202 in 1997, 131 987 in 1995).

In fact, behavioral elements were observed, as the relative stability of real practiced speeds (at on high level), the relative stability of seat belt fastening rate when the optimum rate is far to be reached, and we even see in the public opinion a relative loss of conscience concerning the road unsafety problems, or a growth of accidents involving motorized or not two-wheeled vehicles, or the contrasted evolution of these results with regards to the concerned networks types (relative defacement on the highway, stability on the local network, relative amelioration on the national network, highways excepted). It results that the public authorities consider it necessary to give a new impulsion.

### II. Road safety policy

This new impulsion was decided during the last meeting of the Interministerial Road Safety Committee on the 26 November 1997, whose target is to share by two road unsafety in France in the next 5 years (1998-2002).

To reach this objective, an innovative and ambitious policy is necessary.

It will be developed on three main trends:

- to lean on young people and their capabilities to promote new behaviors. Road users as pedestrians or drivers, they are the first victims of the road unsafety (more than 28% of deaths are less than 25 years ; each day, 6 children or young people die on the road). The prevention, awareness and training actions that have to be sustained all along the life, will be strengthened.
- To develop partnerships around the objectives decided by the government. In order to have the means for answering the growing social demand of safety, the government will have to mobilize all the societal actors, the State Services of course, but also the companies, associations, local communities and insurance companies.
- To guarantee the freedom to move around safely. Driving is certainly a private activity, but it is above all a social act that has to respect the basic civic values as taking into account the others, and the liberty to move around safely. This means simply, clear and intangible rules.

Four measures groups were decided :

**To increase the awareness and train all along the life**

- To educate before to be old enough to get the driving licence :
  - training actions will be developed from the childhood in the scholastic and the extra-curricular framework.
  - it will be possible for all the young people to pass the general theoretical examination ("le code") when they will be 16. The content of this examination will be modernized.
- To train the young drivers :

* within 30 days in 1997 : 8 444

- a 6 hours time rendezvous for evaluation and training will be proposed to the young drivers after one year of driving (free for young people) ;
- a compulsory additional training will be brought in for the young drivers authors of serious infringements to the Highway Code (license points training course), besides the usual sanctions.

- A continuous training rendezvous every 10 years for the drivers will be experimented in several counties.
- To reorganize and clean up the working of the companies dedicated to the driving teaching, and to improve their services quality.

**To guarantee the freedom to move around safely**

- The excessive speeds are the first cause of road mortality. A 5th class measure (at the maximum : 3 months' driving ban and 10 000 FF fine) will be brought up in order to punish the drivers who will exceed the speed limits more than 50km/h. This contravention will be transformed in offense if the same infringement is observed into the year.
- The imperfections of the control / sanction system, when the control is realized with an automatic device, can allow people to avoid the sanctions, and that leads to inequalities in front of the law. A legislative disposition concerning the car owners pecuniary liability will be finalized.
- The sanction process will be simplified by the cancellation of the administrative commissions for the driving license suspension. The judicial process becomes the general rule, and the administrative process taken by the Prefect is reserved to the more serious infringements (drink-driving, failure to report an accident).
- In order to improve the safety of the moped riders, the mopeds will be registered.
- The research of illicit substances will become compulsory in the cases of fatal accidents. So, the knowledge on the substances affecting the control of the vehicle will be improved. In the same time, a pictogram will be printed on the medication packaging when these substances can have negative effects on the driving

**To improve the infrastructure safety**

- The cyclist safety will be strengthened (creation of special spaces before the traffic lights, authorization to ride in the pedestrian areas...) and the Highway Code will be modified in this way.
- Restraints devices (crash barriers) less aggressive for the bikers will be studied and their use developed
- A systematic safety audit for the new road projects will be enforced in order to be sure that they contributes to the users safety and they incite the drivers to a safe driving.

**To support the local policies**

The Interministerial Committee propose to the "Départements" (equivalent to the Counties) to set up a local organization in order to improve the involvement of all the partners and to have a better assessment of the leaded policies.

A part of the measures concerning the road users training and the drivers training comes from the results of the Consultation on the training launched in 1996, and that explains also the necessity of a partnership with the companies involved in road safety.

In the same time, we have to remind that France participates to the preparation of European policies, statutory ones included, this being attested by its active attendance in the European high level groups involved in road safety or intelligent transportation systems, or in the works of the European Economics Commission of UNO.

It is the same for the international activities concerning road safety within the OECD, the ECMT, or concerning the vehicle field related or not to EEVC or CEN, for the IHRA and ISO activities.

### III. The progression of Research and Development

Far be it from me to repeat what was previously said on road safety at an European level in the framework of the 4th FRDP (Framework Research and Development Program). The last two years were dedicated to the preparation of the 5th FRDP, that should be approved this year, safety being one of its major concerns, at the level of research for a sustainable and safe transports policy, but also at the level concerning research on vehicles.

In the same time, the national effort was continued through the activities of the national Program PREDIT2 (1996 - 2000) on the different fields of the themes "safety and ergonomic" and "intelligent transportation systems", that is to say :

- accidentology and biomechanical studies.
- the modeling of collision phenomena,
- imminent hazard warning systems and the localization of accidents,
- training and safety tools,
- vehicle design and infrastructures.

In the same time, besides PREDIT 2 themes, the scientific and technical concerned community, particularly in and around INRETS, has studied thoroughly :

- the introduction of new methods concerned with providing solutions to the problem of serious injuries in addition to that of fatalities with attention being given to relationships between ethics and science (Rhone's Road Accident Trauma Registry acknowledged by the French Health Ministry, the taking into account of the Helsinki's agreement concerning the experimentation),
- the compatibility between vehicles using the same infrastructure,
- multidisciplinary work on the trio infrastructure-vehicle-driver/passenger, not forgetting the problem of our ageing society,
- the progression of our understanding simulation - modeling around the creation of a knowledge dedicated to the research and development.

## CONCLUSION

You will be presented with a large number of French works during this conference, from the manufacturers, the equipment suppliers and the research institutes, and I think that they will demonstrate the challenge France intends to take up with respect to road safety.

# United Kingdom

**Keith Rodgers**
Department of the Environment Transport and the Regions

## Introduction

I am delighted to be here in Canada to present the United Kingdom's Status Report for the second time at an ESV Conference. Our Chief Mechanical Engineer, Mr Malcolm Fendick, sends his apologies for not being able to be with us today and sends his best wishes for an informative and successful conference. I will in the next few minutes explain the UK's current position with regard to vehicle safety and some ideas on how these might develop in the future.

## The UK's Road Safety Target

Since my last report the UK has been working hard on developing a strategy for a new casualty reduction target. Our current target is due to be replaced in the year 2000. There has been a consultation exercise carried out within the road safety community in the UK and these views are now being taken into account in formulating the way forward.

Although our current target has been most successful in focusing the road safety communities' attention on the measures needed to reduce casualties there was a flaw in that there was no discrimination between killed and serious injuries on the one hand and slight injuries on the other. What we are now finding is that the percentage reduction required for killed and seriously injured is being met, but the numbers of slight injuries are not reducing giving the impression that the target is not being met. For the future the decision has been made to stratify the target for each type by severity of casualty and, perhaps, road user so that it will be easier to see where the policy is having the most effect.

One of the main areas providing a step change in road casualty reduction is that of new technology now being introduced into the vehicle fleet. Primary safety has benefited from improvements in anti-lock braking, enhanced by better tyre and suspension technology. Developments in secondary safety include improved structures, better restraint systems and pedestrian protection. Motorcyclists have benefited from improved helmets and there is potential for both improved primary and secondary safety but these areas have proved most difficult to cater for. I show here a table of the improvements to road casualties that we estimate could be achieved from various actions.

By the next ESV our target will be defined and in place. Whoever makes this report in 2001 will be able to tell you about these and the initial reduction towards the target.

## EURO NCAP

In my last report I informed you about the UK's intention to carry out research into the feasibility of a UK NCAP scheme. Even at the last conference these plans were developing and the Swedish Government made overtures at that time to join together with the UK in developing a joint NCAP scheme. In December 1996 an international grouping was formed with the UK, Sweden, the FIA, the International Consumer Groups, and the UK motoring Clubs. The title adopted for this grouping was Euro NCAP.

In February 1997 Phase I of Euro NCAP published the results of tests on seven super mini sized cars using a new system for informing the consumer about the crashworthiness and pedestrian protection of cars. This utilises a star system that goes from I to 4 stars, and is backed up by more data, which shows the levels of protection for various body regions for the driver and front seat passenger, as well as showing the risks of injury to adult and child pedestrians from the front of the car. Instrumented child dummies, fitted in child restraints, are used to determine the level of protection provided for children.

Phase 2 was launched in July 1997 covering 12 family sizes saloon cars, and Phase 3, launched on 28 May, is covering 12 smaller family saloons. The results of these series of tests can be seen in the exhibition on the NCAP stand. Future plans include our fourth series of results to be released in September 1998 covering large saloon cars.

The original membership for Euro NCAP has been increased now with the inclusion of the Dutch Government and a regrouping of the motor clubs under the FIA[1] and AIT[2] and the German motor club ADAC[3], joining as a single member. Perhaps the most exciting

[1] Federation Internationale de L'Automobile
[2] Alliance Internationale de Tourisme
[3] Allgemeiner Deutscher Automobil-Club e.V.

development has been that DGVII, on behalf of the European Commission, has now promised support for Euro NCAP and they have provided funding in 1997 and 1998.

One of the main aims of the European Commission supporting Euro NCAP is to encourage greater funding to enable whole market sectors to be tested at one time. For the future Euro NCAP will probably move away from large group tests but will be aiming to test all new models as they come onto the market.

The UK is investigating the potential of applying NCAP principles to primary safety features. This is seen as a logical, but difficult, extension of the present programme and one which would aid still further consumer choice.

I would now like to come onto those areas of legislation concerned with vehicle safety, which the UK has been dealing with over the last two years.

**Electronics**

The growth in the application of electronic control of vehicle systems, and the complex relationships that may be present as a result, are raising concerns in Europe. The rapidly developing technology presents new problems for the safety evaluation of new vehicles under the European Type Approval system. A specialist UNECE ad hoc group, chaired by the UK, is considering the possibilities of a new Type Approval methodology for these systems.

**Mini Bus and Coach Seat Belts**

Since we were in Melbourne hearing about the Australian experience over coach seat belts our national regulations have been amended to require vehicles transporting children to have seat belts fitted. There were some spectacular accidents involving children that made these changes inevitable, including one involving the deaths of 12 children in late 1993. It was decided that these changes were to be retrospective and therefore mini buses and coaches not originally fitted with anchorage points for seat belts have to comply. As you can imagine this has provided a very difficult technical situation which we are still managing in a detailed way. These vehicles are now coming up for annual inspections and it is a considerable challenge to determine which installations are acceptable.

**Bus and Coach Safety**

We have a range of research projects supporting bus and coach safety for the current negotiations within the European Union on a new directive for large PSVs. The areas being investigated include escape routes, fires, barriers, standing passengers and a whole spectrum of other issues. The basis for our investigation starts with accident data but then proceeds through design solutions and advice to operators for any retrospective changes.

**Truck Accidents**

Despite having legislation governing the construction standards of heavy vehicles, accidents involving trucks are still of concern. Anti-lock braking has been a mandatory requirement on heavy towing vehicles and their trailers for several years. Publication of the long awaited revision of the European Braking Directive provides us with the opportunity to consider an extension of anti-lock braking requirements to all "working" vehicles over 3,5 tonnes. The UK is also involved in a comprehensive evaluation of the relationship between the design and in-service braking performance of heavy vehicle combinations. It is intended that this work will lead to improved road safety by changes to international construction standards.

Accidents involving both trucks and passenger cars are another concern, and the UK is fortunate in having legislation for effective sideguards, rear under-run guards and spray suppression equipment on most heavy trucks. As car structures and their safety equipment improves there are new opportunities to protect car occupants. Work continues for the collection of accident data and details of occupant injuries both in cars and trucks. This has led to work on improved cab strength testing procedures, as it is evident that the compulsory wearing of seatbelts by truck drivers will only be fully effective if the cab structure maintains a survival space. Of course these studies also point to the fact that there are real problems over crash compatibility between cars and trucks, as well as between trucks within the UK vehicle fleet.

**Crash Compatibility**

To attempt to address these problems the UK has an existing compatibility programme, which has been running for two years and will be used to support the work of EEVC WG15 and IHRA[4]. Work so far has been to investigate the extent to which physical parameters affect incompatibility and so hopefully being able to define the problems and indicate possible solutions. This work has been carried out using crash testing and computer modelling.

[4] International Harmonised Research Activities

From initial studies elsewhere of the various national vehicle parcs it is clear that the proportions of types of vehicles vary considerably from country to country. It has always been clear that there are more small cars in Europe than in the US, but what was not so evident was the effect of the sport/utility market sector in the US.

Modelling work is being developed in the UK for feeding into EEVC WG15. The US are constructing a series of finite element models of generic vehicles in the US vehicle parc. These models are to be made available through WG15. Models of the vehicles which are common to the US and European vehicle parc will assist in work to harmonise any test protocols that are developed. This work is ongoing and will be reported to the conference in other sessions.

**Conclusion**

The UK continues to put a great deal of priority into improving the safety on our roads. However much of what needs to be achieved requires international co-operation both in the fields of research as well as agreeing on new regulations which have to be adopted Europe wide and hopefully can be internationally harmonised. The ESV continues to be a source of inspiration and a means of establishing cross-links with what is going on elsewhere in the world. I look forward to the rest of the conference. Thank you very much.

**Annex**

## POTENTIAL KSI SAVINGS BY 2010 IN THE UK

| No | Measure | % Potential Reduction in KSI by 2010 | | | | |
|---|---|---|---|---|---|---|
| | | Car Occu-pants | Pedestri ans | Cyclists | Motor-Cyclists | HGV Occu-pants |
| 1 | Side impact protection | 7.00 | | | | |
| 2 | Frontal impact protection | 7.00 | | | | |
| 3 | Euro NCAP | 15.00 | 10.00 | | | |
| 4 | HGV energy absorbing front underrun | 6.00 | | | | |
| 5 | Seatbelt-ignition interlocks | 1.00 | | | | |
| 6 | Improved compatibility | 0.40 | | | | |
| 7 | Smart adaptive restraints | 0.50 | | | | |
| 8 | Improved vehicle lighting include DRL | 0.70 | 0.70 | 0.40 | 0.70 | 0.70 |
| 9 | Compulsory ABS for HGVs | 0.90 | 0.30 | 0.40 | 0.40 | 3.00 |
| 10 | Compulsory ABS for cars | 0.20 | 0.60 | 0.60 | 0.60 | |
| 11 | Rear impact for cars | 0.10 | | | | |
| 12 | Intelligent HGV speed control | 0.20 | 0.10 | 0.20 | 0.40 | 3.00 |
| 13 | Electronic brake control (EBS) | 0.10 | 0.20 | 0.20 | | |
| 14 | Improved child restraints ISOFIX | 0.40 | | | | |
| 15 | Stronger, larger HGV sideguards | 0.10 | 0.10 | 0.90 | 0.05 | |
| 16 | Improved fire protection | 0.20 | | | | |
| 17 | Stronger HGV rear underrun guards | 0.10 | | | | |
| 18 | Improved safety steering wheel | 0.01 | | | | |
| 19 | HGV front and side vision | | 0.10 | 0.20 | | |
| 20 | Fitment of ABS to all motorcycles | | | | 1.00 | |
| 21 | Motorcycle leg protectors | | | | 3.00 | |
| 22 | Motorcycle airbags | | | | 2.00 | |
| 23 | NCAP for motorcycles (NMAP) | | | | 4.00 | |
| 24 | Optimised crash helmets | | | | 7.00 | |
| 25 | Daytime running lights for motorcycles | | | | 3.00 | |
| 26 | Pedestrian protection directive | | 8.00 | | | |
| 27 | Fitment of stronger cabs and use of 3 point seatbelts | | | | | 4.00 |
| 28 | Improved COP on HGV load restraint | 0.30 | | | | 1.00 |
| | **Total Potential % Reduction in KSI by 2010 for each user group** | **40.21** | **20.10** | **2.90** | **22.15** | **11.70** |

# Italy

**Claudio Lomonaco**
Ministry of Transport

## ABSTRACT

This paper will provide an overview of the progress of the Italian government in the field of road safety. It reports the present Italian situation and the strategy to cope with specific issues of the country and to rules that are acted by the new European Union frameworks. At this aim the topic has been focused on three main road safety actors that are: man, vehicle and infrastructures.

## INTRODUCTION

It is necessary to have at least a concise account of the general conditions to really understand what happened in Italy during the last three years as far as safety is concerned.

Italy has roughly 57.5 million inhabitants, 38 millions of which have a driving licence.
Italian vehicle fleet consist of 31 millions of which are passenger cars, 3 million of commercial vehicles, 2.5 millions of motorcycles and 6.650 millions of mopeds.
The Italian road network has a global length of 6,500 km as far as motorways are concerned, and the total length of the other roads is of about 312,000 km.
This network due to the Italian orography is affected by an important amount of mountain tracks.

**Competencies in Traffic matters.** - The main Ministries of the Italian Government involved in this complex matter are:
The Ministry of Transport, which has competencies on vehicles and drivers.
The Ministry of Public Works, whose competence covers the infrastructures;
The Ministry of Environment that is competent for the various aspects of Traffic and motor vehicles affecting the ecosystem.
I am an official of the Ministry of Transport, responsible of the Department concerning the Regulation related to the construction of motor vehicles.

## STATE OF THE PROGRESS IN ROAD SAFETY

Considering the three main subjects of the road Traffic: The man, the vehicle and the infrastructures, we will point out the prominent phenomena, the present trends in the many fields and the most recent initiatives in progress in my country aiming at improving Traffic safety.

### The Man

**Driving licence** - The road users' fitness to drive motor vehicles can be told to be the point of top interest. The European Union has issued a Directive harmonising both driving licenses and their issuance conditions, including judgement criteria about capacities and psycho-physical conditions of the applicant.

a) Disabled people driving. - An aspect that had an interesting development in Italy is the one concerning vehicle driving of disabled. The EEC Directive on driving licences establishes the main criteria to determine whether the applicant, although disabled, has nonetheless the fitness requisites to obtain a "special" driving licence. In Italy most part of these criteria were inserted into our Traffic Code and in parallel many activities have been started to improve the mobility of disabled people in the recent past. In fact an important project to implement specialised Centres, where the residual abilities of disabled are evaluated, has made it possible, also through a fruitful co-operation with motor vehicle manufacturers, the establishment of a process to remove "bureaucratic" and "practical" barriers that have been limiting so far the mobility of disabled.

This project is already in an advanced phase of development in Italy, while it has been started in other European and extra-European countries. In Italy 11 Centres were built in the main areas of the country. At these sites disabled are visited by a specialised medial staff and are given a global report on their residual capabilities to use vehicle driving devices. This is accomplished by means of a test rig simulating driving conditions, whose data are sent to a computerised equipment. Moreover disabled may try driving on an adapted vehicle, thus acquiring a comprehensive view of the possibilities to recover mobility.

This project was so appreciated that the E.U. Commission DG VII asked for the involvement of the manufacturer's experience in the INCA initiative (Inventory of the European legislation and regulations for Car Adaptation), which is a study of mobility problems of disabled in Europe.

This study has been consolidated by establishing a specific group, constituted by people from Organisations involved in disabled mobility in some European Union countries (CARA for Belgium, CBR for Netherlands and Mobility Unit for United Kingdom), from test laboratories (TRL for United Kingdom, TUV for Germany and TNO for Netherlands) and from car manufacturers (Fiat Auto for Italy).

The INCA Group has firstly the scope to supply a scenario of law requirements on driving license granting and on the approval of adapted vehicles to be driven by disabled. In addition the Group will prepare, at the end of its work, some guidelines to enable the EU Commission to start harmonised initiatives within the European Union to the aim at improving mobility of "European disabled" within a frame of Traffic safety addressed to all European citizens without discriminations.

b) Young people driving - Inexperience and rush are two of the most prominent characteristics of youths who are mainly involved in severe car accidents with respects to older drivers.
In order to limit this hazard several actions are possible.

The first one concerns the conditions that involve the new driver in the first spell.
Generally speaking, in Europe the driver may drive only after the driving license delivery. Namely after twenty hours of driving lectures, which of course can offer a very limited driving experience.

In Italy and UK the candidate to the driving licence gets a temporary driving permission after a preliminary examination, which qualifies him to drive on condition to have on his side an experienced driver. The good results come out by the Italian and British experience have leaded the French govern to introduce the "guided driving". This action allows the youths to drive at sixteen years old in company with an expertise driver and to have attended the theory lectures by a driving school.

Statistical data demonstrate that the first spell of two years, after the obtaining of the driving licence, are the most dangerous. In order to prevent this situation the formation of very young people and children, finalised to an increased road safety, is relevant. First of all because it could avoid a huge part of accidents where very young people and children are involved. Secondly it is an indirect tool to shape the mentality of future adults in order to prepare them to the future responsibility as drivers and road users.

For the above reasons, the road safety is part of school teaching programmes in overall European countries nowadays.
Anyway, the regularity and the quality of these programmes, even their existence, are extremely dishomogeneous from country to country and also from school to school in the same member state.
One of the possible way to cope this situation could be to introduce exams to the release the driving licence also for mopeds. Such action has been already adopted successfully by France.

c) Saturday night accidents - A phenomenon which is becoming relevant and touching the public interest, cause the social repercussions, is the Saturday night accidentology.
Such terminology is used to point out the high number of road accidents, which come out from Saturday nights. They are caused, frequently, by the exit of youths from discotheques.
Fatalities reach the highest level within the Saturday night time zone since 24 until 5 in the Sunday morning.
Such time zone has been cited several time into the legislative proposal aimed to reduce the opening hours of the discotheques.

Actually, it has been demonstrated that the 63.5 % of young people involved in accident were moving for fun.
It has to be noted that Saturday nights accidents involve mainly male drivers which have an age within 19 and 25. The 34% of accidents involve young drivers with the driving licence obtained since one year before.

Another factor which increases the number of casualties is the behaviour to drive in company of many people (in a lot of cases they are too many). The average of people recorded in each crashed car is 2.8 people.
The driving under alcohol or drug effect is not a secondary aspect of Saturday night accidents.

The present Italian legislation does not allow to record clues concerning the psycho-physical state of drivers involved in severe accidents, such as: the alcohol rate present in the blood (TAS), the assessing of exciting state or drowsiness, derived by the assumption of drug or medicine etc.
As a consequence this leads to biased surveys which report only cases where an abnormal driver's state resulted clearly visible by the police service.
Notwithstanding, the Italian Statistical Institute (ISTAT) records 1500 severe accidents each year, caused by an abnormal psycho-physical state of the driver: drunkenness caused by alcohol, drug assumption, medicine assumption or drowsiness.

These data are probably underappraised but the first information that they imply is the high level of dangerousness caused by these factors.

Certainly in the other European countries the public attention is very sensitive about this issue. The rate of accidents caused by alcohol is relevant in all the member countries. Anyway in Italy the recorded increment of these last years lets suppose also a proportional increasing of the submerged data of the phenomenon.

As a first measure, the Italian government has increased police controls on the roads, in strict proximity of discotheques during the most critical hours.

Furthermore public information campaigns, have acted programmes and advertising messages to make road users aware about effects of alcohol and drug consumption on the driving behaviour.

Immediate low cost solutions. - Recently the Commission has presented to the European parliament several low cost proposals (less than 1 million ECU per saved life). In case of adoption by the member State, these actions could perform efficiently to cope with the Traffic safety.

Road casualties would decrease about 15 %, if the safety belts were used overall the European Union like in the Member State which really fulfil this obligation.

It would have a reduction of casualties from 5 to 40%, if authorities succeeded to oblige or convincing to quit driving when people has an alcohol rate higher than 0.5 g/l.

Road victims would decrease over 16% if drivers did not drive under drug or medicine effect.

It is also advisable, that public information campaigns would be acted to educate and to improve the knowledge of a proper consumption of alcohol related to the limits fixed by the law.

**The vehicle**

As far as the vehicle is concerned, I think that the most meaningful news are concentrated on the harmonisation work in progress in Europe to entirely accomplish the European Union, in terms of type approval procedures of motor vehicles. In January 1998 the mandatory harmonisation process for passenger cars was completed : the type approval is now granted by applying the same procedure in all E.U. Countries.

Within the law requirements established by the E.U. in the last length of time we may recall the endorsement of frontal and side impact tests, based on biomechanical criteria, a series of more stringent requirements on the installation of safety belts in motor vehicles, particularly small buses. In addition, in the field of active safety new Directives on braking and on the installation of lighting and light-signalling devices have been issued. Then it may be helpful to remind here that also the public transport was taken into consideration with the works to prepare a new Directive on bus construction. In particular also transport exigencies of disabled were accounted for, this being a very complex problem in the frame of public transport.

I would like also to draw your attention on what the UNO/ECE has at the stage of final approval three new draft Regulation concerning the safety of gas propelled vehicles:

-One for LPG

-One for CNG

-One for retrofit equipment either LPG or CNG

The Italian Delegation directly contributed drafting the last two proposals, basing them on its experience in this field, gained on a fleet of in-use CNG vehicles of about 200,000 units and a significant presence of LPG vehicles (about 1,300,000 in-use vehicles).

Another contribution, from the point of view of the renewal of the car park, was the introduction in Italy of incentives to eco-vehicles, included those equipped with gas propulsion.

The growing presence of low emission vehicles implied the urgency of harmonised requirements, even in this field, devoted, not only to new vehicles, but also to adapted in-use vehicles. This because it was interesting to reduce emissions from in-use vehicles too, making use of the mainspring of the economic advantage of LPG and natural gas with respect to traditional fuels, petrol and diesel. To make it possible, with the assurance of an installation conform to valid safety principles, it was necessary to prepare requirements tailored to the type of technology used, hence pressure systems fitted with safety devices suitable to prevent burst and fire.

**Infrastructures.**

The basic information on this subject is that in our country the 85% of the transport of goods is carried out on roads in a mostly mountainous are and extended more in length than in width. This causes traffic jams roads and environmental problems.

The political approach to this situation is basically to transfer part of this transport to the rail network or to the Intermodale transport. This could result, in the future, in an amelioration of the critical status of the road Traffic.

Contemporary the economical situation, in these last years, imposed general budget restrictions so that the main public works on the road network had consequently some important restrictions. Thus it was decided to devote the remaining efforts to improve the roads in the most critical areas (especially enlarging the main motorways and highways where it was recognised the presence of "black points").

# Japan

**Shoji Watanabe**
Ministry of International Trade and Industry

## Introduction

My name is Shoji Watanabe and I represent the Automobile Division, Machinery and Information Industries Bureau of Japan's Ministry of International Trade and Industry. It is a tremendous honor for me to present the Status Report on Japan in behalf of the Japanese government at this international conference on automobile safety.

Today, I would like to report of the current state of automobile safety in Japan after two years, when the status report was given during the last conference held in Melbourne.

## The Status on Traffic Accidents

When the previous report was given, the number of fatalities caused by traffic accidents had exceeded the 10,000 mark. Since then, the number of accident-caused deaths has declined for two consecutive years, marking 9,640 last year, down by nearly 300 from the year before last.

Although there may be various reasons for the decline, the foremost factor probably is improvement in safety technologies, including measures taken toward automobile crashworthiness. This is followed by improvement in emergency action in case of an accident - specifically, the contribution of the paramedic who has been allowed to ride the ambulance. Furthermore, we believe that traffic safety education, improvement of traffic safety facilities, etc., that are being carried out diligently on continuing basis are slowly bearing fruit.

Let me report the status on traffic accidents.

In Japan, fatalities among youths aged between sixteen and twenty-four and elderly persons aged sixty-five or over totaled 5,178 in 1997, accounting for more than half of the total number of deaths.

In terms of circumstances of death, the largest number were car drivers or passengers, counting 4,251 or 44.1 % of all deaths. The second were pedestrians, numbering 2,643. In the breakdown by age and circumstance, the largest number were aged pedestrians who totaled 1,566. This is followed by young car drivers, numbering 1,168.

Compared to last year, there has not been any increase in the number of fatalities exceeding 100 in either breakdown by age or by circumstance. It is believed that there is no significant change in the number of fatalities, remaining roughly constant at around 10,000. In view of the falling birth rate, the number of accidents involving youths is expected to fall in relation to other age groups. This trend is already seen in last year's traffic accident statistics. The number of fatalities among youths riding motorcycles has dropped dramatically.

In the breakdown by time of day, accidents involving fatalities account for 54.8%, or the larger part of fatalities than accidents occurring during the day. Lastly, the breakdown of fatalities by type of accident shows that vehicle-to-vehicle accidents account for 46.9%, vehicle-to-pedestrian accidents 27.8%, and accidents by single vehicle 24.7%. The three categories make up 99.4% of all fatalities.

## Traffic Accident Surveys

Surveys on traffic accidents provide basic information in assessment of circumstances involved in accidents and to developing safety measures. Without such surveys, appropriate action on traffic safety is probably not possible. In Japan, analytical studies on traffic accidents have been conducted with the establishment of the Institute for Traffic Accident Research and Data Analysis in March 1992.

In the publicity booklet the Institute publishes several times every year, findings based on accident data analyzed from various perspectives are made available nationwide, providing timely data on traffic accident trends among the elderly and relationships between vehicle models and accidents.

The Institute not only studies into macro data gathered on a national scale but engages in in-depth studies on microscopic level as well. The Tsukuba survey office has been set up in Tsukuba City in 1993 for full-scale in-depth research. The study involves gathering data items numbering in several thousands for analysis in as greater detail as possible.

## Improvement in Automobile Safety

As the technical index on automobile safety, the Council for Transport Technology submitted under commission of the Minister of Transport its third report in 1992, from which aggressive action was to be promoted in development of technologies in "accident avoidance," "damage mitigation," and "post-collision injury mitigation." These indices were defined in view

of the rising motor vehicle speed caused by development of expressway networks, growing trend toward nighttime activities, rising age of the population, and others.

In order to address issues concerning betterment and reinforcement of regulations or provisions in regulations, revision of safety regulations and "promotion of safety research" as medium - and long-range policy were announced. I would like to present the principal actions taken in these areas. Starting in April 1994, regulations were strengthened on frontal crash tests and on high-speed braking performance.

Braking requirements for trucks and buses have also been boosted. Starting in February 1996, performance requirements for head lamps has been revised partially. Automatic lighting of head lamp has become a requirement for motorcycles as well. Lateral crash tests will also become compulsory starting this October.

Currently, research is under way on information display devices such as car navigation systems, protection of pedestrians including study into frontal structure of vehicles, and other areas of improvement in automobile safety.

Next, I would like to report on the research coordination program approved at the 15th ESV International Conference. Preparations have been made in Japan last year, and action on each theme is currently under way. Since Japan has become the leader nation in pedestrian protection, we intend to contribute actively on each theme, including hosting meetings in Japan.

As part of the effort to promote automobile safety, the National Organization for Automotive Safety and Victims' Aid is offering on experimental basis automobile safety information to car users in general since 1991. The information has included names of specific motor vehicle models since 1996, and the Institute plans to work on greater improvement in data availability.

**Advanced Technologies**

The Advanced Safety Vehicle (ASV) Plan that the Ministry of Transport executed as a five-year plan from 1991 to 1995 was able to produce a conceptual design of a safe, next-generation vehicle through production and demonstration of nineteen prototype vehicles and proposal on twenty items regarding advanced safety technology.

The second ASV Plan has started in 1996, which study is being conducted into human interface for preventive safety and accident avoidance, alignment with transportation infrastructure, etc. The new Plan covers not only passenger cars but trucks, buses, and motorcycles as well and is expected to contribute to advancement in motor vehicle safety technologies in the coming century.

In Japan, action on Intelligent Transport Systems (ITS) has progressed with five relevant government ministries and agencies developing a general plan in July 1996. Based on this plan, efforts are being made into research for advances in navigation systems, electronic toll collection systems, safe driving technologies, etc., along with improvement in transportation infrastructure.

We are planning to announce the outline of Japan's system architecture for ITS at the next ITS World Conference in Seoul.

**International Harmonization**

Although motor vehicle standards are believed to reflect the social climate, conditions in traffic accidents, traffic environment, and other elements in a country, we believe that international harmonization of standards must be studied in face of rapid progress in international marketing of motor vehicles in recent years and the need to ease distribution on the international level.

Therefore, Japan has just announced its plan to participate in international standardization activities at the UN European Economic Committee's Motor Vehicle Structure Group (ECE/WP29) and to join the revised 1958 UN ECE agreement, the agreement on mutual approval of motor vehicle devices, etc., through activities of the Japan Automobile Standards Internationalization Center (JASIC) established in 1987.

Although regulating motor vehicle performance is not an easy task because of the diversity of changes in automobile performance by driving conditions and other environmental factors, harmonization is essential considering that automobiles are being distributed internationally and wield great influence on transportation and economic activities. Hence, Japan plans to contribute aggressively to international harmonization.

**Conclusion**

In concluding my report, I would like to thank the government officials of the United States and Canada for their work in organizing this conference and earnestly hope that this conference bears many important results and greater friendship among the participants.

Thank you very much for listening.

# Australia

**Peter Makeham**
Federal Office of Road Safety

## ABSTRACT

This paper reviews Australia's involvement in reducing road trauma in both the domestic and international arena since the 15th ESV in Melbourne, Australia.

The paper will focus on the following points:

- National Road Safety Strategy
- International Harmonised Research Activities committee
- Intelligent Transport Systems
- International Harmonisation
- New Vehicle Safety Regulations

## NATIONAL ROAD SAFETY STRATEGY

The National Road Safety Strategy is the cornerstone of Australia's road safety initiative, linking as it does the policies of all major bodies in road safety. Following its collective development by these bodies, it was adopted by Australian governments. The strategy is a collegiate document which has been endorsed by 47 organisations, which include:

- Federal/State/Territory governments,
- local governments,
- health & education agencies,
- police,
- vehicle manufacturers,
- transport industries,
- motorist associations,
- insurers, and
- community groups

The principal components of the Strategy are to:

- reduce the nation's road toll to 8 deaths/100,000 population by the year 2005;
- set road safety directions and priorities for national application, introduce best road safety practice across Australia; and
- ensure road safety efforts are linked to health, education and other portfolios, and are included as a critical part of future transport and land use planning policies.

The Strategy has led to focussed national action plans. The latest of these Plans, developed in 1997, has increased the priority directed towards traffic enforcement; rural road trauma and pedestrian road safety and vehicle standards.

Federal and State Governments have agreed to focus on the key causal factors involved in the road toll. The areas being targeted include:-

- Rural & remote area factors particularly high risk behaviours such as drink driving, speeding, fatigue and non use of seatbelts (notwithstanding Australia's high overall seat belt wearing rate).
- Vehicle standards which represent world's best practice. Harmonisation with international standards in a manner which enhances Australia's road safety performance.
- Alcohol and drink driving with a high emphasis on isolating those drivers who are continuing to drive with high blood alcohol levels.
- Speed management particularly to introduction of speed zoning to reflect the relative safety of some sections of road.
- Traffic law enforcement aimed at adopting best practice and ensuring the community understand the police role as one of road safety first.

- Fatigue management including programs to simultaneously reduce risks and improve productivity in the road transport industry.

- Research & public education activities targeting the causes of fatigue.

- Young driver competencies research and on-going development of driver competency standards and their application in driver training and licence testing.

The Strategy has been successful. The road toll has been reduced by 16.4% since 1991. The 1997 road toll of 1,764 fatalities is the lowest since 1950. The first three months of 1998 has shown further improvements.

## INTERNATIONAL HARMONISED RESEARCH ACTIVITIES

It is now two years since the formation of the International Harmonised Research Activities (IHRA) committee at the 1996 Enhanced Safety of Vehicles Conference in Melbourne.

At that inaugural meeting, IHRA identified six priority research areas where coordinated research effort could be focused to maximise global outcomes using the limited research resources available to us. These six areas were:

- Functional equivalence
- Intelligent Transport Systems
- Advanced offset frontal crash protection
- Vehicle compatibility
- Biomechanics
- Pedestrian safety

### Functional Equivalence

The USA and Australia worked together to prepare a paper to examine the functional equivalence of regulations.

Functional equivalence has considerable potential as a transitional stage to full harmonisation. It aims to provide a bridge between standards applied by different countries which provide similar levels of injury reduction even though the technical segments and test procedures may differ.

The paper sets out a methodology for assessing standards having similar objectives which could be considered to be functionally equivalent, and therefore able to be mutually recognised. The paper was distributed widely for comment and has now been adopted by IHRA as a suggested methodology to examine functional equivalence.

### Advanced Offset Frontal Crash Protection

FORS participated in the European Experimental Vehicle Committee (EEVC) Working Group 11 work on developing ECE R94/01 and notes that the test procedure has been through a comprehensive validation program for passenger vehicles. However, Australia, and other countries, wish to extend the offset frontal test procedure to other vehicle categories in the future. To achieve this, further research will be required on barrier specification and test speed. While Australia has carried out some limited testing on a modified barrier design, resource constraints limited the extent of the work.

Australia believes that further work in offset crash protection needs to be mindful of the issue of vehicle compatibility and supports the IHRA initiative to link consideration of these two matters.

### Vehicle Compatibility

Vehicle compatibility is about equalising crash outcome between unequal crash partners.

Australia supports the move from self protection (minimising the injury of individual vehicles) to a wholistic approach to minimise injury outcome for the whole vehicle fleet.

Australia has done work in developing an energy absorbing truck under-run barrier that tries to address the mass and geometric mismatch in truck/car crashes.

Within Australia, government, industry and consumer groups are involved in a cooperative research program aimed at developing a computer simulation technique to optimise side impact protection to minimise injury over a range of side impact scenarios. Once proven, such a methodology can be extended to the whole vehicle to design for maximum protection in all crash types. Ultimately, this should result in vehicle designs that are optimised with vehicle compatibility in mind.

### Biomechanics

In early 1998, Australia participated in a the worldwide evaluation of the new advanced frontal dummy, THOR. The results indicated that THOR was more humanlike in its responses during testing than Hybrid III. THOR appears robust and able to discriminate between changes to the restraint system design. This ability will become increasingly important as "smart" restraint systems are being developed in the near future. THOR has been evaluated by government, industry and research organisations worldwide with encouraging results. Australia would support early considerations to make THOR the globally harmonised frontal test dummy for regulatory purposes.

Much work is being done worldwide on a number of side impact test dummies. However, Australia is concerned that insufficient emphasis is being placed on converging to a single regulatory side impact dummy. Australia strongly supports the efforts of the IHRA Biomechanics WG in coordinating research towards this important goal.

Research institutes in Australia are continuing to work on establishing the mechanisms of neck (whiplash) and head injuries.

**Pedestrian Safety**

Pedestrians account for about 20% of fatalities on Australian roads annually.

FORS is funding work at the Road Accident Research Unit at Adelaide University to examine the performance of popular Australian passenger cars to the draft EEVC pedestrian safety test procedure. This testing is part of a project to evaluate whether the draft EEVC test procedure is relevant in the Australian situation.

The Road Accident Research Unit has been investigating pedestrian crashes for many years and is continuing its work on head injury mechanisms. This research is being provided to both the IHRA and ISO working groups for consideration.

Australia supports the development of a globally harmonised standard to improve the pedestrian friendliness of vehicle front structures.

## INTELLIGENT TRANSPORT SYSTEMS

Australia has had an ongoing role in ITS research, on both a national and an international level.

The Federal Office of Road Safety (FORS) has a close relationship with ITS-Australia, which was established in 1992 by representatives of industry, government and academia to promote the orderly introduction of ITS technology into Australia. FORS has provided a grant to allow ITS Australia to undertake a research project on the benefits of ITS in Australia.

FORS is also involved in promoting the intermodal benefits of ITS applications through involvement in the Transport and Logistics Working Group of the Supermarket to Asia Council.

FORS has taken a lead role in the development of a coordinated national strategy on ITS in order to maximise the potential benefits from ITS, and avoid implementation problems by promoting interoperability.

APEC and the OECD are also developing strategies for the implementation of ITS for these reasons, and Australia is responsible for leading the projects in both cases.

In the APEC forum, Australia is leading a project for the Transportation Working Group. This project involves the identification of transport problems in the APEC region, and the development of a framework of standards, and a rationale for this framework, for the initial application of ITS technologies to address these problems.

The OECD project is to form the first of three elements of a strategic vision for the integrated implementation of ITS in the OECD. It examines strategies for ITS implementation. The second element is to examine the effects of ITS implementation, and the third is to assess contributing conditions for ITS development.

Australia is also involved in the development of standards relating to ITS. A Standards Australia Subcommittee, chaired by the FORS, was established in 1995 to develop Privacy Principles to apply to ITS. The principles developed by this group have since been endorsed by the Australian Transport Council and a Code of Practice for the Electronic Tolling Industry is currently being developed.

Australia is taking a lead role in many other international activities and developments concerning

ITS. For example, Australia has strong representation on the various Working Groups on the International Standards Organisation (ISO) Technical Committee on ITS. Australia is setting the pace internationally in the area of privacy protection for ITS and the principles are attracting world wide attention. A copy of the Privacy Principles has recently been forwarded to the International Standards Organisation.

## INTERNATIONAL HARMONISATION

The importance of standards harmonisation has been recognised for centuries as necessary to overcome the uncertainties of trade. As the world became more complex, recognition of standards harmonisation has become more urgent.

Benefits from standards harmonisation should not be underestimated. Gains from standards reform in APEC in all sectors has been put at $US200 - $US400 billion.

The work occuring in the APEC Transportation Working Group under the leadership of Australia will assist in realising the benefits for the automotive sector promised by the Bogor declaration.

The Bogor declaration made in 1994 provided the vision for APEC:

- Free and open trade and investment in the Asia-pacific region, no later than 2010 in the case of industrialised economies and 2020 in the case of developing economies.

With agreement that standards harmonisation is an essential component to achieve this goal, APEC economies agreed on some common themes to guide this work:

- Align APEC economies' mandatory and voluntary standards with international standards.
- Achieve mutual recognition among APEC economies of conformity assessment in regulated and voluntary sectors.
- Promote cooperation in technical infrastructure development to facilitate broad participation in mutual recognition arrangements in both regulated and voluntary sectors.

Being a strong believer in international automotive standards harmonisation, Australia proposed the Road Transport Harmonisation Project to APEC at the April 1994 meeting of the Transportation Working Group in Auckland.

The project proposed three objectives:

- Identify current arrangements for vehicle construction regulations, mutual recognition of conformity assessment and certification.
- Identify and develop strategies to provide harmonised requirements for road vehicles.
- Identify and specify national standards for road user requirements and identify strategies to provide harmonised requirements where appropriate.

The third objective was not pursued immediately. However, last year, Chinese Taipei proposed a project to take this issue further. This project has the potential to make a significant contribution to reducing the tragic road toll in the APEC region.

To achieve the objectives of vehicle standards harmonisation, the APEC Road Transport Harmonisation Project proposed five phases :

1. Survey the regulations applied in the region.
2. Pilot project to analyse a small number of passenger car design features regulated in the region.
3. Analyse the vehicle design features regulated in the region to identify commonalities and differences.
4. Examine the conformity assessment and certification arrangements utilised in APEC
5. Develop a harmonised regulatory regime

In phase 3 a consultant analysed APEC wide regulations applying to over seventy automotive design features. This provided APEC members with an improved understanding of each others automotive regulatory requirements.

In phase 4, work is being conducted during 1998 on conformity assessment, certification and recall regimes in the APEC region.

Phases 3 and 4 provide the building blocks necessary to develop a harmonised system for vehicle regulations and conformity assessment requirements in the APEC region.

Planning is now underway to reach our ultimate goal of harmonised arrangements for the APEC region. The final phase is anticipated to take five years to complete with work commencing in 1999. This will not be an easy task but with goodwill and the cooperation which has been a feature of APEC we are looking forward to meeting the challenge.

**Transportation Working Group's Collective Action Plan**

The first initiative was to encourage APEC members to engage in dialogue with the United Nations Economic Commission for Europe Working Party on Transport (UN/ECE WP29).

In April 1998, Australia and Mexico hosted an international road vehicle standards harmonisation seminar as part of the 13th Transportation Working Group meeting.

Representatives of government automotive regulatory agencies and major automotive industry groups from APEC member economies attended the seminar together with representatives of international motor vehicle and motor cycle manufacturers, consumer groups and the UN/ECE WP29.

The seminar achieved its objectives of raising awareness of the standards harmonisation activities of UN/ECE WP29 and developing strategies to progress the automotive standards harmonisation agenda in the APEC region. The seminar provided valuable input in determining the future direction of automotive standards harmonisation activities for the APEC Transportation Working Group.

Recognising the trade facilitation benefits achieved through automotive standards harmonisation, APEC governments were encouraged by participants to increase involvement in the activities of UN/ECE WP29 to accelerate alignment of APEC domestic automotive standards with international standards.

**Model Mutual Recognition Agreement**

The second important initiative of APEC Road Transport Harmonisation Project was the development of a model Mutual Recognition Arrangement for automotive product to facilitate trade in the region in the short to medium term until harmonisation has been achieved.

The model provides an agreed overarching document for use by APEC economies to establish bilateral or multilateral arrangements where signatory governments agree to ensure traded product meets the technical regulations of the recipient economy. It does not attempt to set standards or harmonise standards between the signatories but it does allow the parties to accept product with the assurance necessary that its local requirements have been complied with.

These arrangements will reduce domestic inspection requirements on imported product and increase the level of confidence in the capability of the technical infrastructure in the exporting economy.

The model mutual recognition agreement was endorsed by APEC transport ministers at their meeting in June last.

## NEW VEHICLE SAFETY REGULATIONS

The Federal Office of Road Safety (FORS) has put into place Australian Design Rule 73/00 to implement UN ECE Regulation 94/01 for offset frontal crash protection. ADR 73/00 will be introduced for new passenger car model approvals from 1 January 2000.

ADR 73/00 will be introduced in addition to ADR 69/00 for full frontal impact occupant protection.

ADR 69/00 was introduced in July 1995 and is based on US Federal Motor Vehicle Safety Standard 208 with the important difference being that ADR 69/00 is a restrained only test with a perpendicular impact direction. This difference has allowed vehicle manufacturers to optimise their airbag systems for restrained occupants.

ADR 72/00 for dynamic side impact occupant protection will be introduced in January 1999 for passenger cars. This Design Rule will accept compliance with either US FMVSS 214 or ECE Regulation 95/01. Work is currently underway to extend this requirement to four wheel drives, and light commercial vehicles.

FORS has also completed a project to examine the feasibility and benefits of a harmonised side impact standard. The paper on this project will be presented this week during the conference.

## THE FUTURE

As we move into the 21st century, Australia supports the IHRA initiative for coordinated research in major areas to improve road safety.

It is important that we do not lose sight of the "big picture" – of how these research areas might interact to improve both vehicle and road safety. We must be careful to ensure that improvement in one area does not degrade safety in another.

We must be mindful of the horrific road toll in developing countries. Our work in APEC is not only about trade facilitation but will also bring about significant reductions in road trauma in developing countries by making safer cars available at an affordable price.

# The Netherlands

**Gerard J.M. Meekel**
Ministry of Transport

## INTRODUCTION.

Some four years ago the Ministry of Transport, Public Works and Water-management in the Netherlands set up a working-party to look into the basis for a coherent package of measures related to vehicle policy. This package consisted of measures aimed at

- new technological developments
- enhancement of safety features and
- optimal economic use of heavy goods vehicles

The main goals for the long term are

- development and promotion of an intelligent vehicle
- promotion of hybrid propulsion

and for the short term

- continuing improvement of collision safety
- optimisation of the use of heavy goods vehicles

What was the background for this study? There are numerous improvements which can be introduced to enhance the safety of vehicles. It is more important to recognise and establish those measures which are the most promising in terms of cost/benefit, and which together constitute a coherent and logical set of measures. At the same time, steps should be taken to ensure that those measures which are not an integral part of package are not neglected.

Motor-vehicles traffic creates a micro-macro paradox. At micro-level, based upon arguments we all know well, the individual car user considers it as an ideal means of transport. However, at macro-level, the community considers it as having an adverse affect on safety and the environment, of course caused mainly by the "neighbours and all the others".

With this new vehicle-related policy, and depending upon the type of problem, one can opt for either technical changes to vehicles, alterations to pricing policy, influencing the buyer's or driver's behaviour, stimulation of public transport, or new infrastructure. The preferred option is for measures which are of a structural nature rather than those which merely tackle symptoms.

Paying close attention to vehicle-related policy is one means of attaining goals for accessibility, enhancement of traffic safety, environmental protection, economy and energy-savings. The Ministry of Transport, Public Transport and Water-management in the Netherlands has focused its vehicle-related policy on accessibility and traffic safety, while paying requisite attention to environmental aspects. The success of any policy, including those mentioned above, is heavily dependent on sufficient support from the users and those organisations which serve the interests of the consumers, the environment, public transport, etc.

In order to be successful and attain a position from which to influence certain developments it is necessary to have available sufficient technological research centres where knowledge is developed on a national basis.

## CHOICE OF PRIORITIES.

Development of a sound vehicle-related policy depends on a several participants: consumers and vehicle manufacturers world-wide, the electronics industry, research institutes, European governments and organisations, governments in neighbour states, national and local governments in one country and different departments within one government (economic affairs, environment, finance). All these participants, including the Ministry of Transport, have their own restricted possibilities for attaining their pre-determined goals. This results in a balancing of the activities of the government, according to the constraints imposed by the available manpower and financial resources.

The question therefore arises of how to reach an optimum package of measures from the 160 measures which were evaluated. After careful evaluation of all possible measures, the most promising are considered to be those related to technical innovation, namely:
- the development of an intelligent vehicle
- the development of alternative propulsion systems, mainly the hybrid propulsion.
However, these two developments will have a noticeable effect only on a long-term basis.

At the same time the decision was made to continue with the present-day activities related to improving collision safety and optimisation of heavy goods vehicles: a great many positive results are still possible, given sufficient action and measures with regard to collision safety aspects. In addition, heavy goods vehicles are considered to have sufficient potential for enhancement of safety and environment, such as improvements in logistics, collision safety, road traffic behaviour and emissions.

One reason for these greater expectations for HGV's may well be the fact that less attention was paid to this category of vehicles in the past. A balance was to be found between short term and long term activities, as was a balance between measures related to accessibility (e.g. centres of cities), traffic safety environment, energy and economy.

## HIGHLY POTENTIAL MEASURES.

One of the most promising activities is the realisation of a standardised set of design specifications for an electronic architecture in the car, for communication between vehicle and road, and between vehicles themselves. Opportunities relate to:
- dynamic traffic information
- intelligent speed adapters
- electronic vehicle identification
- on-board computer (e.g. OBD)
- collision avoidance systems
- autonomous intelligent cruise control
- automatic vehicle guidance systems.

Another set of promising measures relates to propulsion systems and (alternative) fuels in order to attain environmental and fuel efficiency goals. Most promising for the short term are the use of hybrid vehicles, and the use of LPG/LNG. With highly efficient small conventional combustion engines, a fuel consumption of 2-3 litres/100 km can be attained. Influencing the consumer when buying his car can also be successful with the use of, for example, tax incentives.

## PASSIVE SAFETY.

In this area the reduction of the negative consequences of a collision has still great potential; improvements to the bodywork, safety belts, child restraints, and side-impact protection. The EURO-NCAP programme can have positive consequences to safety aspects of vehicles. However, this programme should be part of a broader scheme, preferably within the European Community, with a greater number of participants and with stricter rules concerning the application of results found during the test programmes.

## HEAVY GOODS VEHICLES.

During the last ten years technological aspects have been improving steadily, but there is still potential for improvement in environmental aspects such as emission and noise, and fuel efficiency. Reduction of mileage by better combinations of cargo, resulting in higher loading ratios and better use of road capacity and infrastructure are other measures which yield positive results.
Heavy goods vehicles are involved in 20% of the annual 1200 road traffic fatalities.
Improvements with great potential concern the front and rear under-run protection devices and side guard. In addition, better side guards, e.g. with closed surfaces, have special potential in relation to contacts with vulnerable road users (pedestrians, cyclists) and can reduce the injuries in 35-50% of the accidents.

Another aspect is the optimisation of the maintenance of heavy goods vehicle from its first kilometre. This improves environment and reduces the overall costs for the vehicle or fleet-owner.

## CONCLUSION

The study, which started some years ago, on the optimisation of the actions resulting from a vehicle-related policy within the Ministry of Transport, Public Works and Water-management underlined the categories of vehicles, the aspects and items which have promise with regard to enhancements in safety, environment and economy, and accessibility of e.g. city centres for the short and long term. Programmes have been running from some years. Most promising for the long term are the development of intelligent vehicles and the promotion of hybrid propulsion.

One interesting programme is the twelve-kilometre test-track for the study of automated guided vehicle systems in the Netherlands, which will be in use as from June 15, 1998.

The Ministry of Transport will continuously analyse the opportunities for enhancing safety and environmental aspects of vehicles. At the same time it will analyse the cost/benefit aspects of these measures and optimise its input with manpower and financial sources.

# Sweden

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## ABSTRACT

A reduction of road traffic fatalities and serious injuries in Sweden started in 1990 and has continued until 1996. However, during 1997 a slight increase of fatalities was observed. The road safety work in Sweden has been stepped up during the 90ies. A new national road safety programme was presented in 1994. The Vision Zero, which was presented in 1996, was accepted by the Parliament in 1997, as the basis and long term target for the Swedish road safety work. A new national road safety programme is now under development.

On specific international topics, Sweden has been active in a project aiming at independent consumer information about car safety (EURO-NCAP), in field trials with Intelligent Speed Adaptation (ISA), in development of ISOFIX standardised anchorage for child seats and in developing intelligent belt reminders. Special national topics are quality control of road safety, a large fleet study of alco-lock effectiveness and development of a safe travel policy. In the research area, in-depth studies of all fatal road accidents, studies of neck injuries in rear end crashes, roadside to vehicle crash compatibility, tire characteristics in accidents, pedestrian protection in collisions with cars and crash recorder data, could be mentioned.

## ACCIDENTS, INJURIES AND FATALITIES

The first specified Swedish road safety target, for maximum number of road traffic fatalities per year, was set to 600 when the yearly fatalities was 800 in the late 80ies. That target was reached in 1994. Then a new target was set to maximum 400 by the year 2000. We have not really got much closer to that target since then. The fatality figure 1997 was 570. That was an increase by six percent compared to 1996.

The main part of the increase in fatalities is car drivers on winter roads. Both number of seriously and slightly injures persons have increased. Only seriously injured pedestrians have decreased. The main part of the increase has happened on main roads, not in built up areas.

The passenger car covers more than 80 percent of the personal transport in the country. Two thirds of the fatalities are car occupants. 85 percent of the fatalities of car occupants occur outside built-up areas. For pedestrians and cyclists the vast majority of fatalities occur in collisions with cars within built-up areas.

The higher the age the higher the number of killed pedestrians and cyclists. Mopedists (drivers of small motorcycles) are the only road user category for which the fatality age curve is bimodal. The tops are at age 15 and age 75. The motorcycle fatality curve has its maximum at about 25 years of age. The top of the car occupancy fatality curve is about 30 years of age. These frequency figures are of course the result of both risk and exposure.

## ROAD SAFETY POLICY

The Swedish Parliament came to a radical and very brave decision in October 1997. Then it was decided that The Vision Zero should constitute the long term target and the policy basis for road safety work in Sweden. That means that the ambition will be the same in road transport as it is for instance in flight transport and in rail transport – nobody should be killed or seriously impaired.

Not everybody realises how radical this decision is. In fact it means an almost total change of policy. Earlier we accepted the safety we could get when the transport and mobility requirements were fulfilled. What the Swedish Parliament is now saying is that we will have the mobility and transport efficiency that our safety requirements permit.

A proposal put forward by the government is that the short term road safety target is to reduce the number of road traffic fatalities to not more than 300 by the year 2007. That is a reduction of almost 50 percent from the 1996 figures. That would mean less than 2.8 fatalities per 100.000 inhabitants. The present figure is almost twice as high. A road safety programme for the years 1999-2007 is now being developed.

As usual road safety work may be carried out along three axes:
- Reduce exposure
- Reduce accident risk
- Reduce crash consequence

It is the product of the achievement in each one of these three axes that decide the results.

Historically we have worked intensively to reduce accident risk. The results have however not quite reached our targets. One of the reasons is the

compensatory behaviour of the drivers. In the last decades we have worked quite successfully to reduce crash consequence. We have so far not really systematically worked to reduce traffic exposure. The strong pressure along that axis comes today from the environmentalists. We should join our forces.

Acceptance of the Zero Fatality Vision as the basis for our road safety work means a change of gravity from accident prevention measures to reduced crash consequence and exposure measures. There are a number of possibilities to achieve reduced consequences of a crash:

- reduced violence in car and along road in case of a crash (e.g. car fronts and sides, motor ways, obstacles along the road, crash barriers, poles)
- improved personal protection of road users (e.g. belts, helmets)
- reduced speeds
- improved rescue, treatment and rehabilitation

Road improvements and to some extent car improvements have the advantage that they may improve safety at the same time as mobility, transport efficiency and environment. On the other hand they have the disadvantage that they cost money. Unfortunately the government did not decide to invest in road improvements. Therefore most of the efforts so far are concentrated on speed reduction.

## STRATEGY

Traditionally the government instrument to improve road safety in general and vehicle safety in particular has been by regulations. This instrument has, however, a serious disadvantage. It is slow:

- Regulations do not represent the most recent knowledge. It takes time to agree on regulations and they are therefore based on old knowledge. You could even say that they normally are obsolete when they are published.
- Regulations do not make full advantage of existing knowledge. Regulations are often compromises, in which the slow and/or weak party has considerable power to reduce its potential impact.

However, we no doubt need regulations to set the minimum requirements. But we should use other instruments to compliment regulations and to speed up the process of safety improvement. One such complimentary method is consumer information. The modern educated consumer is a very powerful and quick actor. There are many examples of quick consumer actions in the vehicle market that have completely changed the situations.

Consumer information may however, only be fully used on some conditions:

- The information must be impartial
- The information must be up-to-date
- The information must be realistic
- The information must be accurate
- The information must be comparable
- The information must be fairly complete

Probably the most important is to agree on a test method. We think a good example of consumer safety information is the EURO-NCAP, a joint European crash test of the most common European cars of different size. Many countries carry out car safety assessment. In a joint effort Sweden, UK, a number of motoring and consumer organisations and EU carried out crash tests during 1997 and 1998 on front impact, side impact and pedestrian impact. The results are published and widely distributed. The test should be expanded because it is still far from complete. We believe the results will have quick and considerable impact on consumer behaviour and if so also on manufacturer behaviour.

One major road safety problem for authorities has always been to influence the behaviour of road users, primarily drivers. In an effort to get around that problem the Swedish Road Administration is now trying to convince commercial companies, communities and authorities that they shall require certain safety features when they buy transport.

The idea is that just as well as today more and more companies guarantee that they fulfil certain environmental requirements, they should certify that they fulfil certain road safety requirements. Such requirements might be:

- following the regulations including speed limits
- using well trained and experienced drivers
- having and wearing seat belts
- checking brakes, tires, lighting and other vehicle safety features

Filling the specified safety requirements should be a condition for participating in the tender for contract in passenger transport as well as goods transport. This way safety will be a competition variable for the transport companies. Furthermore the transport companies must certify that their drivers behave safely. Safe driver behaviour will be quality controlled not primarily by the government (the police) but by the transport companies themselves. Today professional drivers behave fairly aggressive and are in those terms often a bad model for other drivers. With company responsibility the professional driver should really be a good safety model for private drivers.

## SPECIFIC PROBLEMS

It is widely realised that speed, alcohol, belt usage and travel modes are directly or indirectly major road safety problems. During the last years we have made some efforts to reduce these problems.

Some large scale field trials of intelligent speed adaptation (ISA), or even implementation studies, are in preparation in Sweden. The purpose is to develop a speed adaptation system primarily for society financed transports, but possible to use also for other transports. The Swedish Road Administration, the communities and the car industry direct the project. Four communities serve as trial areas.

The idea is that the 40 largest towns in Sweden will be equipped with infrastructure for intelligent speed adaptation by the year 2020. This will be used by about 80 percent of the local transports and of course indirectly influence the speed of the remaining transports. On rural roads and motorways the speed adaptation will be mainly vehicle born (e.g. adaptive cruise control).

By these means it will be possible to make speed limits flexible in many ways (e.g. weather, work zones). By the year 2010 most cars will be possible to equipped for ISA. By the year 2020, 95 percent of the cars will be equipped. Initially the system will be used on a voluntary basis. But there are several possibilities to extend that – e.g. to require notorious speeders to be equipped as an alternative to withdrawing their license.

The alco-lock system senses the alcohol content in the expiration of the driver. The car will only be possible to start and to drive if this alcohol level is not exceeding a set value. The system has been tried e.g. in Australia and in Canada. Presently a large scale trial is in preparation in two Swedish counties. The idea is that drivers, who have had their license withdrawn because they have been sentenced for driving under the influence of alcohol will have the possibility to continue driving if they participate in a rehabilitation programme and equip their car with an alco-lock system.

Withdrawing the license is a common penalty for various traffic crimes (see speed and alcohol above). However, because the probability of getting caught not wearing a license is very small many drivers continue driving in spite of not having any license. Therefore withdrawing the license is not a very effective measure. One way of making it effective is to make the license electronic and make it impossible to start the car without the valid electronic license. A programme to develop an effective electronic driver's license is in progress in Sweden since a few years.

The Swedish Road Administration has developed a policy for safe travelling of its employees, partly to increase safe and environmentally sound travelling, partly to support the market for safe and environmentally friendly cars. Many other administrations and commercial companies have also adopted this policy.

One intention with the travel policy is to reduce travelling by car. But the interesting part here, are the requirements specified on a rental or private car to be used in duty by an employee. The following requirements are valid from January 1, 1999:

- weight in working order above 1000 kg
- three point belts on seats used
- winter tires in winter conditions
- fulfil 1989 exhaust requirements
- air bag for driver (from the year 2000)

Sweden has also played a key role in the development of the ISOFIX concept, a standardised attachment for child seats. Since last autumn ISOFIX is factory installed in some European cars and we expect many other vehicle manufacturers to follow.

Until now development of roadside safety features has been somewhat different in Europe and USA. Sweden has tried to act as a co-ordinator with the purpose to improve world-wide harmonisation in this area.

Earlier studies have shown that the wearing rate of seat belts is high in general but low in severe accidents. Only about 50 percent of those car occupants that get severely injured are wearing their belts. Only in Europe 5.000 lives could be saved if all car occupants were belted. Therefore a Swedish project has put forward specifications for an inter-lock system that will put strong pressure on the occupants to wear their belts.

## RESEARCH

One car company (Volvo) and one insurance company (Folksam) have published interesting results from real world crashes recorded by in-vehicle-crash recorders. This gives a new dimension to in-depth studies.

As one of the few countries in the world Sweden is from January 1, 1997 analysing in-depth all fatal accidents in road traffic. This project has three purposes:

- follow up of the road safety situation
- awareness and education of staff
- basis for new research and modified actions

Some of the questions to answer in the present in-depth studies are:

- How many lives could have been saved by safer cars?
- Were seat belts used and if so how?
- Are roll over accident dangerous for belted occupants?
- Which were the speeds in collisions between cars and pedestrians?
- Which effects do bicycle helmets have?

The research programme of the Swedish Road Administration is split into five parts:

- evaluation of safety systems and measures
- injury data and biomechanics
- traffic medicine and traffic psychology
- decision and implementation processes
- interaction between safety and other society and transport goals

One previously overlooked research area that many researchers in Sweden from government to industry are now working with, is the whiplash neck injuries. It is a fairly frequent and treacherous injury, which is often not noticed immediately after the crash but may lead to life-long impairment.

Chalmers University in Gothenburg is one of the main research groups within the crash area. They have carried out a number of studies of the human body characteristics in crashes. One series of studies present results, which improves the understanding of brain injury. Another series deal with a mathematical model of the pedestrian body at impact with a car. A third series tries to analyse the relative significance of car mass, structure, stiffness and geometry in vehicle to vehicle frontal crashes.

The Swedish Road & Transport Research Institute (VTI) is another main research facility. By means of their advanced driving simulator they have carried out a number of studies of the safety effect of in-vehicle informatics. They have also studied accident risks in relation to type of tire used and the injury consequences for pedestrians and bicyclists. The crash laboratory has specialised on child protection and road side equipment.

The Swedish automobile manufacturers Saab and Volvo are among the leading car makes from safety point of view. This position is based on targeted research efforts. Also the insurance companies in Sweden contribute to road safety research in various aspects.

## CONCLUDING REMARKS

The Vision Zero is now widely accepted in Sweden from politicians to the drivers. It has now started to be used as a generator for new countermeasure and research ideas. The start looks promising. But it remains to be seen if it will be as successful as a basis for action and research as it has been as an inspiration source for road safety work and road safety workers.

# Poland

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## ABSTRACT

The following report contains information on the progress achieved in Poland with regard to road traffic safety. At two last ESV Conferences our approach to the road accident casual factors related to vehicle and human behaviour had been presented. This time it will discussed third of the main factors - the road. Additionally the information on progress made during last few years in scope of two other factors is also given.

## ROADS AND TRAFFIC SAFETY IN POLAND IN THE POLITICAL SYSTEM TRANSITION PERIOD

### General description

The human behaviour at the end of 20th century is not always rational. The very significant example of the situation is implicit demand of society in many countries to largely use motor vehicles without taking into account the bad experience noticed in developed countries. The natural consequence of rapid growth of motorization is the necessity of harmonised development of road infrastructure. Unfortunately people first buy vehicles and come to the idea of building the good roads for these vehicles far too late, where both the traffic safety and mobility of vehicles are insistently threaten. The social costs of such behaviour are horrific both with regard to numbers of people involved in road accidents and the sorrow consequence of the accidents. In Poland, in three years 1994-1996 20,000 people were killed and 206,000 were injured. The deaths ratio per hundred accidents was around 11, giving us one of highest results in Europe. The accident data are widely known to the public but it does not stop people to progress in motorization. In response, the authorities in many countries look for effective measures for limiting the negative influence of dense road traffic.

World automobile industry is in majority in private hands and financed by buyers directly through vehicle price, while road construction mostly is paid through state budget, what causes much more easier control of vehicle related safety factors, than factors related to road, especially in countries during transition in which the problem of „short cover" exists in great extent.

The term „road traffic safety" has the scope limited by definition to the incidents on the road and includes also participation of road infrastructure. By now our accident survey results in estimated 10% of total accidents number in Poland, but some experts think the value is lowered specifically with regard to the deal of deaths and serious injuries. It is evident by simple comparison that our roads has been in very poor state (ruts, pits and bumps etc.) during last 10 years, mostly due to very low budget resources for road maintenance.

The total length of road net in Poland is now around 375 thousands kilometres among which there is 46,000 kilometres have the status of main roads called "national roads". In this specific road category:

- 28 % is in state classified as "bad",
- 44 % is in state classified as "warning",
- 28 % is in good or acceptable state.

The first sign of progress in the situation occurred at the beginning of 1998 when 30% of annual fuel excise tax has been devoted by authority for road purpose. Experts say that such level of financing enables only to break further depreciation and repair the worst part of "national roads". It does not, however, allow for new investment in road infrastructure including the transit motorways. Poor finance state is also seen in lack of building the road bypass of the build up areas and modern traffic control (telematics). It is estimated that if the part of annual fuel excise tax for the road reaches 50% the most urgent needs may be satisfied.

As in all aspects of traffic safety the activity must be organised in legal and technical systems. In our way to become the member of European Union we had already published two important ordinances unifying our road and bridge technical specifications for construction and maintenance to EU standards. The road construction survey research shows that large part of existing Polish roads does not meet the EU standards, so there is a need for reconstruction of old and building new roads at least on transit directions. The legal status of responsibility of road authority in our country has to change to direct responsibility in the case of accidents clearly connected to road weak state. The vehicle insurance companies are successfully lobbying in the above mentioned field. We hope that complex activity will lead us to the level of road depending traffic safety comparable to the average EU result in few years time.

### The need for modern roads

Poland due to the geographic position in central Europe is a typical transit country (the annual transit rate of motor vehicles exceeds 27 mln) in the North-South and East-West directions and thus should make use of this advantage in its economy. For this activity there is a necessity to apply adequate network of transport measures, that means motorways and express roads the standard of which should conform to the EU. In practice, that means the roads enabling per axle loads of 115 kN. Our road network is nowadays mostly not yet prepared for such loads.

Accordingly to latest plans, the possibility to fulfil this condition will be achieved provided that:

- motorways A-1, A-2, A-3, A-4/A-12 and A-8 of the total length of 2569 kilometres will be built,
- the additional network of 2300 national roads will be rebuilt or modified for the higher axle loads.

The estimated costs of the exercise should be on the level observed in other developed countries and should not be lower than in the table below:

| No. | Country | Year | The share of road expenses in relation to road taxes |
|---|---|---|---|
| 1 | Japan | 1990 | 148% |
| 2 | Germany | 1987 | 100% |
| 3 | Norway | 1989 | 98% |
| 4 | Austria | 1986 | 99% |
| 5 | USA | 1989 | 83% |
| 6 | Switzerland | 1988 | 79% |
| 7 | Belgium | 1986 | 70% |
| 8 | Denmark | 1989 | 33% |
| 9 | Sweden | 1989 | 33% |
| 10 | Spain | 1989 | 23% |
| 11 | England | 1989 | 23% |
| 12 | Poland | 1995 | 14% |

According to „Sector study of road building enterprises and the base industry. Final synthesis", Road and Bridge Research Institute (IBDiM), Warsaw 1997.

Despite very hard situation in road building sector in Poland, our road building companies are watching the world technology progress and could well compete in the scope of bituminous pavements. Many of them use modern technologies which allow the necessary strength of pavements fulfilling the latest EU standards to be built. With regard to the road signs, there is a substantial progress mainly in both vertical and horizontal road signs where good retroreflective paints are widely used.

In recapitulation it is worth stressing that the only reason of poor state of our roads is the lack of resources remedy this problems.

### THE PROGRESS IN THE FIELD OF VEHICLE SAFETY

In fullfiling of European Treaty further adaptation of Polish law is consequently implemented. The new Road Traffic Code more precisely defines the type approval system and periodic technical inspection system. Five EU directives have been implemented into new MoT ordinance and many others are equivalent requirements to the UN ECE 1958 Agreement Regulations used in the type approval system. The necessary documentation and layout of documents had been unified according to the European Whole Vehicle Type Approval system. Moreover, our country takes part, at its best effort, in the international initiative called International Harmonised Research Activity - IHRA about which you will hear a lot during this event.

### THE PROGRESS IN THE FIELD OF HUMAN FACTOR

Previously mentioned the new Road Traffic Code forced the centrally manned database of drivers and their faults, thus enabling better supervision of drivers behaviour on the roads. Driving license categories are now identical to EU system and a new driver training scheme is also unified to the system existing in developed countries.

### CONCLUSION

Despite all our effort, the road safety level in Poland is still not satisfactory. Taking into account the rapid growth of our car market which is now estimate on the level of more than 0.5 mln. of new vehicle and 150,000 of imported second-hand vehicle a year, it appears necessary to pay greater attention to the problem of safety on the roads. We hope that our presence on ESV and IHRA will help in better and more effective progress in the field.

I wish everybody a good co-operation and fruitful exchange of knowledge in this very important part of everyday life - road traffic safety.

# United States

Raymond P. Owings, Ph.D.
National Highway Traffic Safety Administration

The National Highway Traffic Safety Administration (NHTSA) is challenged to initiate research and generate ideas to ensure that critical motor vehicle research continues well into the next century. It is often a slow process, but one that is critical to maintaining the pursuit of a safe and secure transportation system. The prospect of making transportation safer, laying the foundation for saving lives and reducing injuries through research, is a formidable one, and one that merits our best efforts. The following pages report NHTSA's progress and achievements that have taken place toward these goals since the last ESV conference, and over the longer term.

## CRASH ENVIRONMENT

Last year, the U.S. Department of Transportation celebrated its 30th anniversary. At times like these, it often pays dividends to retrace the path we've traveled to arrive at where we are today.

NHTSA's National Center for Statistics and Analysis (NCSA) reports that from 1992 (the lowest fatality toll for over 30 years) to 1997 (preliminary estimates), deaths on US highways increased from 39,250 to an estimated 42,000. This fatality increase has been associated, in large measure, with an expanding economy and increases in exposure. When contrasted with the 50,894 people who were killed in traffic crashes in 1966, we have seen a 17 percent decline in 30 years.

The fatality rate per 100 million vehicle miles traveled in 1966 was 5.5 (see Figure 1). By 1992, the rate had declined to 1.7, and it has remained at this level through 1997. Of course, the fatality rate decline was not a straight line downward. Rather, there have been periods of little change over the years, such as 1974-1980, 1983-1986, and of course, 1992-1997. However, we believe we are on the verge of breaking through the current barrier, and will be reporting a 1.6 fatality rate around the year 2000. Similarly, the fatality rate per 100,000 population decreased from

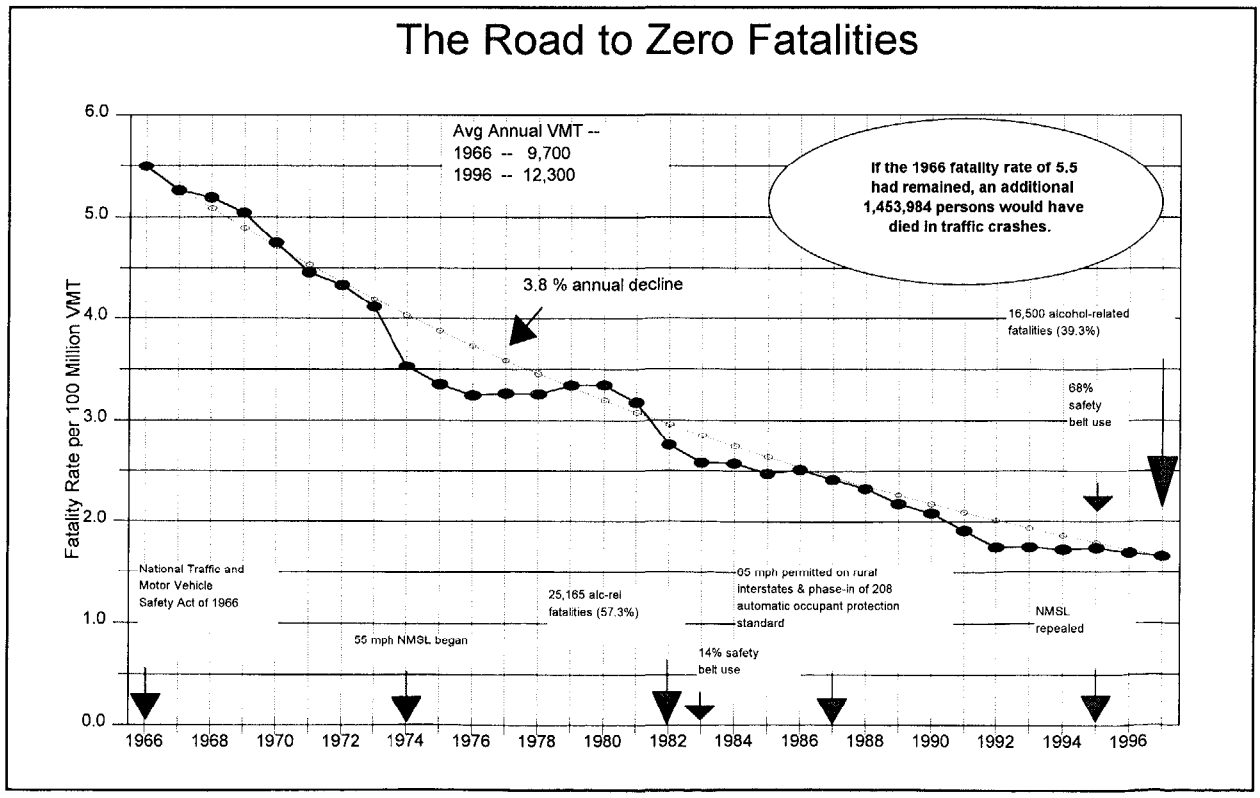


**Figure 1.** Road to Zero Fatalities.

26.02 in 1966 to 15.80 in 1996.

Between 1966 and 1997, the amount of travel on US roadways increased by approximately 170 percent. When compared to the 17 percent decline in fatalities, we must be doing something right! That something is saving lives. Saving lives, to the tune of 1,453,984 through 1997. That's how many more people would have lost their lives if the 1966 fatality rate of 5.5 per hundred million vehicle miles had persisted through 1997.

Passenger car occupant fatalities comprised 53 percent of the total in 1997, and continue to constitute the largest proportion of U.S. traffic fatalities. Light truck fatalities in 1997 were 24.7 percent of total fatalities, an increase from 20.6 percent in 1992. Motorcyclist fatalities in 1997 were 5.0 percent of total fatalities, a decline from 6.1 percent in 1992. Nonoccupant fatalities in 1997 were 14.5 percent of total fatalities, down from 16.2 percent in 1992.

The total number of police-reported crashes in the United States in 1997 was estimated by the National Automotive Sampling System (NASS) General Estimates System (GES) to be 6.753 million, an increase of 13 percent from the 6 million reported in 1992.

Since 1992, traffic fatalities, and the fatality rate, have varied within a relatively small range. A cursory look might give one the impression that we are now in a fairly static period. However, nothing could be further from the truth. There are a number of dynamics at play that are changing the fatality picture. Two of the more dominating factors: changes in the composition of the on-road fleet, and changes in the composition of drivers of this changing fleet.

In 1975, when the Fatality Analysis Reporting System (FARS) began collecting fatal crash information, light trucks (pickup trucks, vans and utility vehicles) accounted for about 18 percent of the on-road light vehicle fleet, about 17 percent of light vehicle VMT, and about 16 percent of light vehicle occupant fatalities. By 1996, the light truck portion had swelled to 34 percent of the on-road light vehicle fleet, 34 percent of light vehicle VMT, and 31 percent of light vehicle occupant fatalities. While passenger car occupant fatalities declined by 3,699 (14 percent), light truck occupant fatalities more than doubled, from 4,856 in 1975 to 10,360 in 1997 (an increase of 5,504, or 113 percent).

This shifting of the purchasing preference of Americans from cars to light trucks is a socio-economic trend, driven by consumer preferences. However, light trucks are designed differently than cars, and perform differently. These differences present certain safety-related challenges. For example, it is well established that light trucks are more prone to rolling over in a crash than are passenger cars. Rollover crashes are second only to head-on crashes in their injury potential. In addition, the likelihood of an injurious occupant ejection is greatest in rollover crashes.

Perhaps at least as important is the interaction between cars and light trucks in roadway crashes. As the population of light trucks has increased from 18 percent to 34 percent, collisions between cars and light trucks have become more and more likely. In 1995, for the first time, more passenger car occupant fatalities occurred in collisions with a light truck, than occurred in collisions with another passenger car.

In 1975, 7,371 passenger car occupants died in collisions with another car, while 2,163 died in collisions with a light truck. By 1996, this picture had changed dramatically, with 4,192 passenger car occupant fatalities in collisions with another car, and 4,417 in collisions with a light truck.

An evolutionary trend to which attention should be drawn concerns the composition of the driver population. For quite some time, but especially since the early 1980's, women have increased their driver licensure at a greater rate than men. This change is even more pronounced for women age 60 years and older. Between 1975 and 1990, growth in the number of female licensed drivers outpaced males by 12.6 percent.

In addition to the increase in licensure, the average annual travel for female drivers also has increased dramatically compared to male drivers. Between 1975 and 1990, average annual miles driven by female drivers increased more than the growth in male driving by 23.7 percent. Taken together with the increase in driver licensing, the total exposure of female drivers increased 39.2 percent more than male driver exposure.

The combination of these two trends has brought about dramatic increases in female driver fatalities. Between 1975 and 1990, see Figure 2 for these trends, male driver fatalities declined by 1.3 percent, while female driver fatalities increased by 62.4 percent. Taken together, female driver fatalities have increased by 65 percent relative to male driver fatalities. These trends have continued through 1997, to the point where the increase in female driver fatalities since 1975 is now 98 percent relative to males. These trends are presented in the graph.

The 1992 report concluded that most of this increase is due to increased licensure rates and increased average annual travel, both leading to increased exposure to risk. However, even after accounting for increased exposure, there was a residual 18.2 percent increase in the fatality rate per mile traveled. This increase has been investigated, but no strong patterns have yet been identified to explain this increased risk. The growth in female driver fatalities is another trend that is expected to continue, as more women enter the workplace, life expectancy increases, and women continue to outlive men.

There continues to be other important issues that require research investments, such as air bags, antilock brakes, intelligent vehicle systems, higher speed limits, and the like. We must continue to be vigilant and monitor the changing traffic safety system. None of these problem identification activities would be possible without a solid basis of data collection, information and analysis.

## DATA COLLECTION AND ANALYSIS

NCSA has been conducting motor vehicle crash data collection for the agency since 1972. In recent years, several important changes have been made to the agency's data collection programs which will benefit not only NHTSA, but the highway safety research community, nationally and internationally.

NHTSA's crash data collection system is composed of several components serving various needs. The Fatality Analysis Reporting System (FARS), which began operation in 1975, is a census of all fatal crashes occurring on public roads in the United States. The National Automotive Sampling System (NASS) is a yearly collection of data from a statistically representative sample of crashes occurring in the United States. NHTSA implemented the first full year of NASS data collection in January of 1979. The program was re-evaluated in the mid-1980's, which resulted in a redirection of the program focusing on vehicle crash protection performance and created a two component NASS system which was implemented in January 1988. The two components are the General Estimates System (GES) and the Crashworthiness Data System (CDS). FARS and NASS are complemented by state crash data files compiled from police traffic crash reports for a number of states.

FARS data has been used to assess the effectiveness of numerous programs, including those that increase seat belt use to evaluate the performance of various occupant restraint systems, including air bags. In 1997, FARS data was made available for analysis on the World Wide Web through the Internet.

In 1995, additional detailed information on air bag performance was added to the NASS CDS. Collection of precrash environmental data in support of the Intelligent Transportation System (ITS) was added to the NASS CDS and GES. The NASS CDS sampling plan was modified in 1996 to increase the number of crashes involving air bag-equipped vehicles in support of the agency's evaluation of air bag system performance and regulatory initiatives. In the summer of 1995, a Pedestrian Crash Data Study was implemented in NASS CDS to update pedestrian injury patterns in impacts with late model year passenger vehicles. In the spring of 1996, a 2-year Unsafe Driver Actions Special Study was implemented in NASS CDS to identify specific action(s) taken by the driver of the vehicle that initiated the crash sequence and further identify the cause of that action.

Since 1972, NHTSA's Special Crash Investigations (SCI) program has provided us with the most in-depth and detailed level of crash investigation data collected by the Agency. The program provides NHTSA with the flexibility to acquire detailed engineering information on crashes of special interest that fall outside the established scope or criteria of other agency data collection systems, for examining the real-world safety impact of rapidly changing technology and exploring alleged vehicle defects. These include but are not limited to investigation of crashes in which an air bag or safety belt system appeared to operate in an unexpected manner, crashes involving alternative fuel vehicles, crashes involving children in restraints, and serious school bus crashes not investigated by other Federal agencies.

As new highway safety issues emerge, the Special Crash Investigations program has the capability to respond quickly for collection of field information to support NHTSA's analysis and appropriate action. Crash data from this program is used to produce monthly reports on fatal and seriously injured children and adults in air bag deployment related crashes.

The objective of the State Data Program is to obtain motor vehicle traffic data files from select states and process those files into databases usable by NHTSA analysts. Each year, the crash data files from 17 states are obtained documented and converted into Statistical Analysis System (SAS) format. Additionally, a specialized crashworthiness database is created from several of the raw state data files. State data files have been used in studies of driver error, antilock braking systems, and center high mounted stop lights, among others.

Through the State Data Program, NHTSA continues to encourage states to improve the usability of their data for highway safety analysis. State crash

data are used at the state level to perform problem identification, establish goals and performance measures, determine progress of specific programs, and support the development and evaluation of highway and vehicle safety countermeasures. Standardization of state data can help to ensure the success of these efforts. Comparable information more accurately identifies where resources could be applied among important programs, provides for better performance measures, and supports evaluation of effectiveness of programs. Standardized data elements facilitate linkage to medical outcome data, thereby helping identify the cost of traffic crashes and, ultimately, who pays. At the National level, comparable state data improve NHTSA and the Federal Highway Administration (FHWA) analyses and the collection and coding of information in Federal data systems, most of which also are used by state and local agencies.

In another component of the State Data Program, NHTSA continues to work with states to develop Crash Outcome Data Evaluation Systems (CODES). CODES links occupant-specific statewide police-reported crash data to medical outcome data, information collected by emergency medical services, emergency departments, hospitals, rehabilitation, and long term care centers, and to other traffic records. These linked data can be used to determine the person, crash, vehicle and roadway characteristics that are most associated with increased injury severity and high health care costs. With this information, priorities can be set that will have the most impact on reducing mortality, morbidity and costs.

The primary component of the CODES program is to provide seed funding for states to begin linking data. In 1997, grants were provided to seven new states to develop CODES, bringing the total to 16 states that have been funded to develop CODES data linkage capabilities or to develop applications for their linked data. Six of the original seven states provide peer-to-peer technical assistance to other states interested in or actually developing a CODES. In 1998, up to six more states will receive CODES grants.

Linked crash and injury databases are a crucial source of medical and financial outcome information for motor vehicle crashes. Unfortunately, not all states are currently able to develop data linkage capabilities. For linkage to occur, states must have computerized, population-based data. Most states have crash and hospital discharge data. Many states are in the process of developing computerized systems for emergency medical services, emergency department and other outpatient data. To facilitate this development, NHTSA, in partnership with the Centers for Disease Control (CDC) and other Federal agencies and national organizations, supports national efforts to standardize these data.

## CRASH AVOIDANCE RESEARCH

### Intelligent Transportation Systems (ITS)

The agency's vehicle-related work has traditionally been divided between injury reduction countermeasures (crashworthiness) and crash prevention (crash avoidance). Traditional work in the field of crash avoidance has focused on how essential equipment such as brakes, lights, and tires can be improved to enhance the crash avoidance capability of the driver. Starting about six years ago, the agency began working on how advanced electronics and other technologies could help assist drivers avoid crash. This work is part of the Department of Transportation's (DOT) Intelligent Transportation Systems program. Results of this work have been reported at the last two ESV conferences.

Since the 15th ESV Conference, we have made significant progress in improving our understanding of how crash avoidance systems need to work if they are to be effective in helping reduce the number of crashes that occur. Some of that work is being reported in the technical sessions of this conference. This work is the cornerstone for a broader program which DOT started about one year ago. The program is called the Intelligent Vehicle Initiative (IVI).

The IVI program emphasizes development and deployment of advanced-technology vehicle-related injury prevention and safety systems. Although the emphasis of IVI is on safety improvements, there is a strong connection with improving efficiency of travel. For example, crashes often cause nonrecurring congestion. Thus, any collisions that can be avoided help reduce congestion and improve traffic flow. There are also systems which improve a non-safety service but secondarily improve safety; for example, high fidelity map data bases. In addition to the focus on improvements in safety, the IVI will provide a synergistic relationship between vehicle-related aspects of transit operation, passenger vehicle systems, and commercial vehicles. This means that within DOT; NHTSA, Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) will be working more closely together as one DOT than they have in the past. We believe that this closer working relationship will provide opportunities for cross-fertilization and more effective utilization of technologies as they become available.

NHTSA's primary role in IVI is to serve as a facilitator in development and deployment of crash

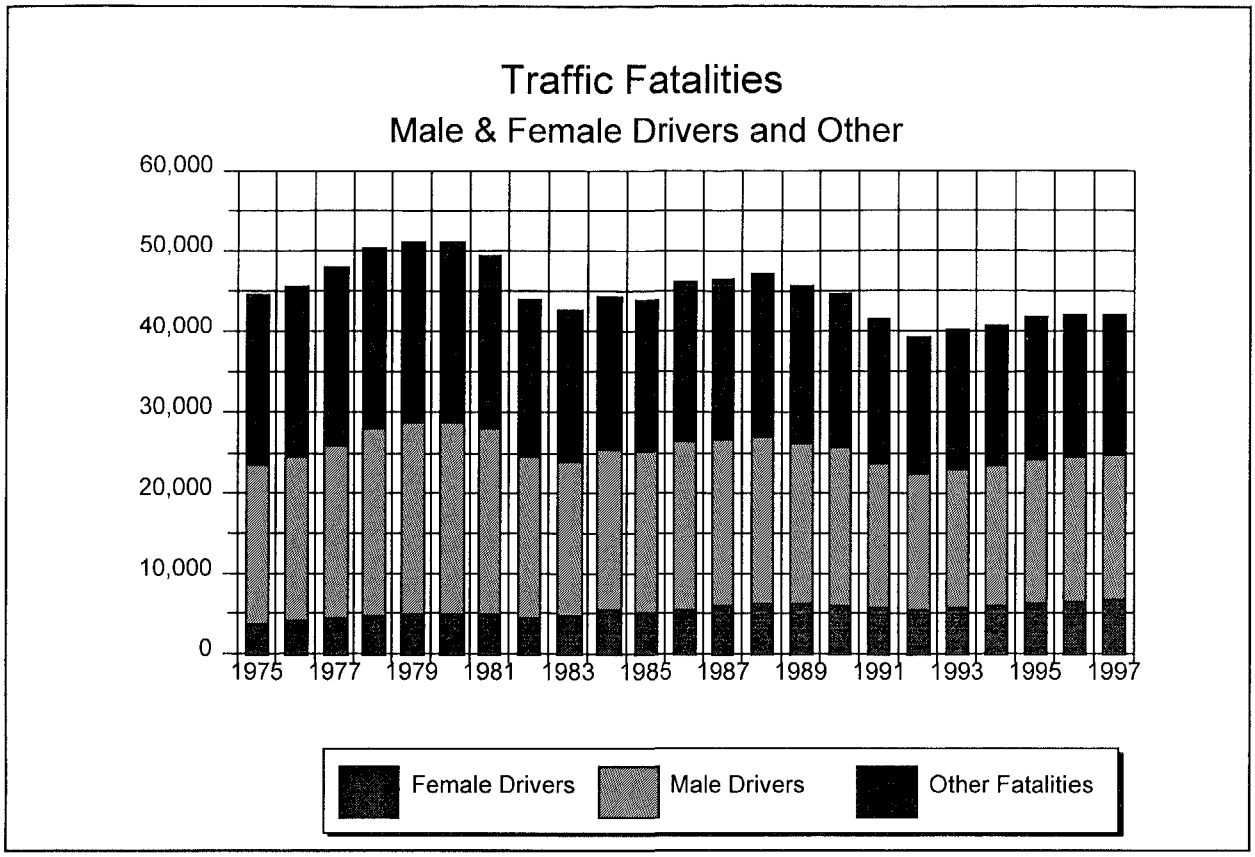


**Figure 2.** Fatalities for Male and Female Drivers.

avoidance motor vehicle systems. We have several capabilities that we think are critical to the successful development of vehicle-related safety systems. We bring an in-depth understanding of the injury consequences of crashes and of how and why they occur. For example, a recent suggestion is that "DOT's most useful contributions would be in conducting research to identify safety needs and understand driver behavior, sponsoring fleet evaluation programs, and helping to educate consumers on the costs, benefits and correct use of ITS products." A key element of doing this type of research is to have a good understanding of how a system must work if it is to truly provide an effective solution to an identified safety problem. This provides a solid basis for definition of objectives and specification of system performance requirements. For example, a recent study has extended the results of an experiment in a driving simulator to develop a set of criteria for when an imminent crash warning should be activated. This study took into account the dynamics of vehicle motion as well as the results of a human factors test to provide one of the core elements of a collision avoidance system. This type of study represents the essence of human-centered engineering and is an example of one of the ways that DOT can facilitate development of effective safety-improvement systems. This study is the subject of one of the poster sessions at this conference.

NHTSA's crash avoidance program has made significant progress during this year, including:

1 - A field operational test of an adaptive cruise control system was completed. This test consisted of 10 passenger cars each of which was equipped with a state-of-the-art adaptive cruise control system. Data was collected on this fleet of vehicles for a year. A full evaluation of results is currently underway.

2 - Another project addressed the producibility of key components of collision avoidance systems. The project addresses system components such as sensors, both radar and laser, and head-up displays. Three generations of forward-looking radar sensors were developed during this project and significant progress was made in reducing the manufacturing cost of these sensors and in improving performance. Major improvements were also made in manufacturing techniques and performance, e.g. brightness, of

reconfigurable head-up displays. The project also demonstrated significant improvements in system performance and in understanding the nature of driver interactions with collision avoidance systems. The results of this project will be combined with results from other NHTSA projects to form the basis for an operational test of a rear-end collision avoidance system.

3 - An operational test of an Automatic Collision Notification system is currently in progress. The system integrates state-of-the-art sensors and communication capability and automatically connects the vehicle with the local Emergency Medical Services (EMS) dispatcher and the receiving hospital or trauma center. Base-line time-of-crash data is being collected for 4,000 vehicles equipped with crash event timers. The objective of the field operational test is to design and field test a prototype system for passenger vehicles that automatically and reliably detects the occurrence of a crash and alerts EMS agencies. The ACN program is intended to reduce the time between the crash and the delivery of prehospital and definitive, hospital-based emergency services to the victims. It will do this by automatically assembling and transmitting a cell phone-based data message, that contains the vehicle location and crash severity data, from the vehicle car to local emergency agencies.

4 - NHTSA recently completed an estimate of benefits that would accrue to the driving public if all vehicles were equipped with just three collision avoidance systems: rear-end, road departure, and lane change. The conclusion was that these systems could reduce the number of collisions by 1.1 million per year in the United States. That represents 17 percent of the current number of crashes. This would also represent economic savings of $26 billion per year. An additional benefit would be the reduction in non-recurring congestion that results from crashes.

DOT recently published a Federal Register notice - request for information (RFI) that would help provide guidance for the intelligent vehicle initiative. The RFI that included a proposed top-level roadmap of how the IVI could move from problem definition to demonstrated performance of preproduction systems and a list of 26 initial services that are candidates for proving motor vehicle safety and travel efficiency. A key element of the roadmap is the development of individual services coupled with operational tests and other evaluation activities to assess the safety and efficiency benefits to highway users. This will be followed by integration of proven services, which would also be coupled with further evaluation. The RFI also asks for expressions of interest in the program, steps that need to be taken to ensure an effective research and development program, and other areas of needed research.

**Driver/Vehicle Performance**

The interaction between the driver and vehicle is a key element in highway safety. With the advent of high-technology systems to improve safety, increase productivity and/or provide greater convenience, the driver is now faced with the increasingly difficult task to assimilate this new information and still safely perform the functions of driving. NHTSA's Driver/Vehicle Performance program conducts research into the interaction between the human and the vehicle, supporting both the Intelligent Vehicle Initiative (IVI) and the agency's more traditional crash avoidance safety improvement programs. Key areas of research include understanding driver/ vehicle performance in naturalistic settings, assessing the safety impact of in-vehicle devices like cellular telephones and navigation systems, and assessing the improvement in safety afforded by new intelligent vehicle technologies.

Measuring driver behavior and performance in naturalistic settings has been achieved using the Data Acquisition System for Crash Avoidance Research (DASCAR). This is a suite of instrumentation that was developed by NHTSA for simultaneous measurement and recording of driver and vehicle behavior during long-term exposure to actual on-road driving experiences. A standardized protocol for the collection and archiving of data collected by DASCAR has also been developed. One of the most important advantages of DASCAR is that it is unobtrusive. The driver does not see the sensors and therefore is not likely to be influenced by the fact that his or her actions are being recorded. The system is also easily installed in any vehicle, so that it can be used in privately-owned vehicles under normal driving situations. NHTSA currently has about a dozen DASCAR systems supporting all types of driver behavioral research.

In order to develop collision avoidance countermeasures that will work effectively, it is necessary to first develop a good understanding of how drivers drive without the help of such systems. This year the agency is using DASCAR to record normative "baseline" driver behavior in roadway departure and rear-end collision scenarios. Data are being gathered in actual driving situations to determine how drivers react in "near miss" situations. This information will be used as part of the development of performance

specifications for proposed collision avoidance systems and associated driver/vehicle interfaces.

Another key area of research addresses the safety impact of new in-vehicle technologies. The agency recently published a report regarding the safety implications of using wireless communication devices while driving. Although the study focused on the use of popular cellular telephones, we believe it also provides insight into possible problems that could result from the use of other in-vehicle devices that require the driver to take physical or mental actions that would divert attention away from the driving task. Other studies are investigating the issue of driver workload in general.

Research has also focused on drowsy driving. This work has produced a highly reliable measure of drowsiness, called PERCLOS, defined as the percentage of eyelid closure over time. A prototype system to measure PERCLOS has been developed, and is currently being tested in actual service on overnight runs by a trucking company. Research is being initiated this year to investigate how such a device might be best used to enhance safety. For example, we want to encourage drivers to pull off the road and rest when drowsiness is detected, rather than using the detection device to help them drive longer, which could possibly result in an even greater risk.

Other research addresses driver acceptance and usability of new technology. Any benefits that are predicted for new intelligent vehicle systems are based on the assumption that drivers will make use of the systems, and use them properly. However, if drivers perceive the systems as being unreliable, annoying, or too prone to false alarms, or if the operation of the systems is confusing to drivers, they may ignore or even disable the systems, thus negating any positive benefits. Therefore, the usability of new technology is being addressed as a key factor in assessing the improvement in safety afforded by new collision avoidance systems.

**Heavy Vehicles**

Although heavy vehicles comprise a relatively small percentage of the vehicles on the road, their high exposure in terms of annual miles driven, along with their size, mass and other physical characteristics, makes them over-represented in terms of involvement in serious crashes. The purpose of NHTSA's Heavy Vehicle Research Program is to foster improvements to heavy vehicle safety.

Much of this research is aimed at improvements to braking. Several years ago the agency conducted a large-scale operational test of antilock braking systems (ABS), before mandating their use on new heavy vehicles. Current programs are developing improved performance tests for ABS. For the future, electronically-controlled braking systems (EBS), especially if used in conjunction with air disc brakes, offer the possibility of significant improvements in stopping capability and stability for heavy vehicles. The use of EBS would also make possible the deployment of a system developed by NHTSA to selectively brake individual wheels to stabilize vehicles during cornering maneuvers. This system would suppress the phenomenon of "rearward amplification," which often induces rollover in multiple-trailer combinations.

Heavy vehicles are subject to rollovers, which not only are severe crashes to the occupants of the vehicles involved but also create massive problems in terms of traffic tie-ups. A system has been developed to warn truck drivers as their vehicle approaches the rollover threshold for safe operation. Future research will explore the possibility of linking this on-board system to an infrastructure-based system, in order to notify the driver of an upcoming curve that may produce a rollover in time for the driver to take action to slow the vehicle to a safe speed.

Work is also continuing to improve the occupant protection aspects of heavy truck cabs, and to support possible future rulemaking regarding truck tire performance and brake lining performance rating.

**National Advanced Driving Simulator**

The National Advanced Driving Simulator (NADS) program has advanced from the design phase to the fabrication phase, after a successful Critical Design Review in May 1997. The official ground breaking for the building that will house the NADS facility at the University of Iowa's Oakdale Research Park was held in October 1997, and construction is underway. The simulator, which will be operated by the University of Iowa, is expected to go on-line in early 2000.

NADS will be the world's most technically sophisticated research driving simulator when it becomes operational. Its mission is to dramatically improve highway safety by studying the complex driver performance and behavior issues involved in potential crash situations. It will allow such research to be conducted for the first time in the safety, controlled, and repeatable confines of the research laboratory. Such research will inevitably lead to the development of new vehicle safety systems that will reduce fatalities and injuries on the road. The cutting-edge technology employed by NADS will also provide the capability for

evaluating the advanced vehicle communication, navigation and control technologies which are now being developed as part of the ITS program, and which will begin to appear in automobiles in the near future. Highway engineering and design research related to traffic safety also will be performed.

## CRASHWORTHINESS RESEARCH

### Vehicle Aggressivity and Compatibility

Light trucks and vans (LTVs) currently account for over one-third of registered U.S. passenger vehicles. Yet, collisions between cars and LTVs account for over one half of all fatalities in light vehicle-to-vehicle crashes. Nearly 60 percent of all fatalities in light vehicle side impacts occur when the striking vehicle is an LTV. In 1996 LTV-car crashes accounted for 5,259 fatalities. In these crashes, 81 percent of the fatally-injured were occupants of the car. These statistics suggest that LTVs and passenger cars are incompatible in traffic crashes, and that LTVs are the more aggressive of the two vehicle classes. In particular, crashes with an LTV cause a disproportionate number of vehicle-to-vehicle fatalities.

NHTSA has initiated a research program to investigate the problem of vehicle aggressivity and compatibility in multi-vehicle crashes. The near term goal is to identify and demonstrate the extent of the problem of incompatible vehicles in vehicle-to-vehicle collisions. The objective is to identify and characterize compatible vehicle designs with the expectation that improved vehicle compatibility will result in large reductions in crash related injuries. Specifically, this program seeks to identify those vehicle structural categories, vehicle models, or vehicle design characteristics which are aggressive based upon crash statistics and crash test data. Light truck and van collisions with cars are one specific, but growing, aspect of this larger problem.

### Frontal Crash Protection

Even after full implementation of driver and passenger air bags as required by FMVSS No. 208, it has been estimated that frontal impacts will account for up to 8,000 fatalities and 120,000 AIS $\geq$ 2 (i.e., moderate to critical) injuries annually in light vehicles. A detailed definition of the remaining safety problems in frontal impacts is underway. Research will investigate real world crash environments and project occupant injuries that will occur for an all air bag fleet. This includes summarizing the human loading and injury tolerances for occupants restrained by air bags in frontal crashes.

This program focuses on the intrusion-type injuries and fatalities and the costly lower extremity injuries observed in crashes involving air bag-equipped vehicles. We believe an offset frontal test best represents the real world crashes that produce the intrusion-related injuries and fatalities and the severe lower extremity injuries. We have been working to develop an offset frontal test, and we have been considering what new injury modes, injury criteria, and test surrogates might be necessary for this type of test.

An analysis of real world crash data using the National Automotive Sampling System (NASS) has been completed and is reported on in a paper "Determination of Frontal Offset Test Conditions Based on Crash Data" for this ESV Conference. Using NASS, frontal impact modes are grouped into general "test" conditions which will best represent the real world impact environment. These general test conditions include full barrier, left and right offset, with collinear and oblique impact directions, and other impact modes. Using these general groupings of impact conditions, the analysis further assesses degree of overlap and impact direction to determine more specifically which crash conditions result in highest injury/fatality to drivers with air bags. Injury/fatality risk is also assessed by driver size and body region/injury source, with a more detailed analysis of leg injuries. Finally, a preliminary benefits analysis is presented for a future, recommended test procedure. Based on this analysis, the offset crash test which represents crash configurations with the highest frequency and risk of serious to fatal injuries is a left offset/oblique, vehicle-to-vehicle impact with substantial overlap. Based on various assumptions, a requirement for a left oblique/offset test procedure could save as many as over 1,000 fatalities, 5,000 AIS$\geq$3 injuries and over 20,000 AIS$\geq$2 injuries each year. Leg injuries alone could be reduced annually by about 11,000 for AIS$\geq$2 and about 2,000 for AIS$\geq$3.

Most recently the offset crash testing has focused on a left oblique type impact for the target vehicle. The nominal test condition is a 30 degree left oblique impact with about 50 to 60 percent overlap on the target vehicle and a closing velocity of about 110 kmph. A 50th-percentile Hybrid III dummy is used as the test surrogate in the driver's seating position. As reported at the last ESV Conference, an initial test in this configuration caused a mid-size vehicle to exceed the FMVSS No. 208 chest and femur criteria. To standardize the test and achieve repeatability, the test is simulated using a moving-deformable-barrier (MDB) to stationary vehicle impact, with a closing speed of

about 110 kmph and an impact angle which best simulates the vehicle-to-vehicle test. Comparison testing has been conducted with car-to-car, MDB-to-car (both moving), MDB-to-car (stationary car) to assess whether the latter test is an adequate substitute for the car-to-car test. Initial assessments indicate that most injury measures and structural responses are fairly similar in the three test configurations. Initially a closing velocity angle of 15 degrees was used and the vehicle was "crabbed" to achieve the 30 degree vehicle-to- vehicle impact configuration. These conditions, besides adding complexity, required substantial refurbishment of the MDB after each test. Currently tests are being conducted to assess the simulation validity for an impact angle between 15 and 30 degrees with no crabbing of the MDB.

**Side Impact Research**

An analysis of the 1988-1996 NASS/CDS and FARS files indicates that side crashes result in over 11,200 fatalities and 36,000 serious injuries each year to occupants of passenger cars and light trucks and vans (LTVs). This corresponds to about 33 percent of the fatalities and 37 percent of the serious injuries in all towaway crashes. Since the last ESV conference, side crash protection research has mainly focused in three areas–development of a pole side impact test procedure, international harmonization research, and analytical modeling studies. Currently, an overall research plan is being developed to upgrade the dynamic Federal Motor Vehicle Safety Standard No. 214, Side Impact Protection, which established minimum requirements for thoracic and pelvic protection for the near-side occupant in side crashes of light vehicles. Analyses have been initiated to provide a detailed definition of the current side impact safety problem.

In a joint program with the Federal Highway Administration to explore protection of light vehicle occupants involved in side crashes with narrow objects, a series of pole side impact tests with the Honda Accord was performed. The crash testing established the seating procedure and feasibility of an optional pole side impact crash test for the current FMVSS No. 201, Upper Interior Protection, rulemaking addressing dynamic head protection systems. The FMVSS No. 201 optional pole test conditions are within the guidelines of a test procedure simulating a narrow object side crash as established by a general look at recent NASS/CDS and FARS crash data files.

**Advanced Air Bag Technology Research**

In recent years, a number of crashes have been reported where injuries and fatalities have been the result of aggressive air bag deployment; that is, the severity and crash environment did not warrant the severity of injury/fatality sustained by the occupant. Those most susceptible to injuries/fatalities from aggressive air bag deployments include out-of-position child passengers, out-of-position adult drivers (usually unbelted), and infants in rear-facing child safety seats. As of March 1, 1998, over 100 airbag related fatalities have been identified. A majority of these fatalities have occurred with unrestrained occupants. About 60 percent are fatalities in children and the remaining are adults.

On March 19, 1997, NHTSA published a final rule that temporarily amends the agency's occupant crash protection standard to ensure that vehicle manufacturers can quickly redesign air bags so that they inflate less aggressively. More specifically, the agency adopted an unbelted sled test protocol as a temporary alternative to the standard's full scale unbelted barrier crash test requirement. The agency took this action to provide an immediate, interim solution to the problem of the fatalities and injuries that current air bag systems are causing in relatively low speed crashes to a small, but growing number of children and occasionally to adults. A research program was defined to upgrade the FMVSS No. 208 injury criteria and test devices, and to develop test procedures for evaluation of occupant injury. The objective of this research activity is to eliminate the fatalities and reduce the severity of the injuries resulting from aggressive air bag deployment, while simultaneously optimizing the benefits to normally seated restrained occupants and restoring the full protection for unbelted adults in high severity crashes. The requirements will be established using the state-of-the-art developments of advanced air bag technology.

To define potential areas of improvement with current air bag systems, various analyses of real world crash data are being conducted. The National Automotive Sampling System is being utilized to analyze air bag-related issues such as effectiveness as a function of driver height and gender interaction, specific body region effectiveness estimates for various sub-populations, etc. Other analyses involve investigations of injuries and fatalities with air bags, analysis of fatalities to children under 15 with air bags, and analysis of injuries/fatalities to adult drivers, specifically to identify cases of air bag aggressiveness contributing to the injuries/fatalities. NHTSA's Special Crash Investigation (SCI) program is one of the main utilities for sending quick reaction investigators

to the crash site when NHTSA learns of serious air bag crashes.

With the introduction of new-generation air bag equipped vehicles into the fleet, NHTSA's SCI program also is investigating the field performance of production new-design air bag equipped vehicles through crash investigations, and has implemented several early notification mechanisms to identify these crashes. NHTSA also has conducted laboratory testing to evaluate the aggressiveness of production next-generation air bag systems in new vehicles. High speed crash tests and static out-of-position tests were conducted on a sample of production vehicles, and results were compared with the pre-1998 air bag designed systems.

To assess the potential of advanced air bag technology for improving air bag performance beyond what is achieved with the current new generation of air bags, NHTSA and NASA's Jet Propulsion Laboratory (JPL) conducted an assessment to identify critical air bag parameters, technology advancement needs, and the time frame for advanced technology availability.

To experimentally assess the potential for advanced air bag technology, NHTSA is conducting testing over a wide range of conditions. Initial hardware evaluations have included advanced crash sensors, advanced air bag inflators, and occupant position sensors. NHTSA has recently completed extensive testing on a vehicle platform equipped with a multistage air bag system and advanced crash sensor. Research included out-of-position tests with small female driver and child passenger test dummies, sled testing with small and large adult dummies representing moderate severity crashes of varying crash configuration and restraint application, and high-speed, full-vehicle crash tests to test complete system performance.

Research is being conducted to develop test procedures for evaluating advanced air bag system performance. To minimize air bag risks to occupants in close proximity to the air bag at the time of deployment, static driver and child out-of-position test procedures have been developed; research is being conducted to develop test procedures to evaluate air bag suppression systems (quasi-static and dynamic); and research is being conducted to develop a full scale dynamic crash test involving pre-impact braking. NHTSA also is working on a joint research program with Transport Canada to develop a low speed deformable offset crash test procedure utilizing small female dummies, as well as evaluating the occupant protection afforded to small females in high speed crash conditions.

In conjunction with the development of new test procedures, NHTSA is working toward the certification of alternative test dummy sizes, such as the 3-year-old and 6-year-old Hybrid III children, the 12 month CRABI dummy, and the 5th percentile female and 95th percentile male Hybrid III adults. Calibration procedures, out-of-position testing, and sled testing are being performed with these dummies. NHTSA is conducting numerous experimental and analytical research programs in biomechanics to improve the human injury tolerance relationships used to interpret dummy responses across the full spectrum of test dummy sizes. Two major areas of research are in the development of improved thoracic and neck injury criterion as these will be used to account for a large number of air bag induced injuries and fatalities in the field due to the impulsive loading of the air bag system. Additionally, a research program has been initiated to investigate improvements that can be made to test dummies to properly mimic the characteristics of human occupants for use in testing advanced occupant sensors that utilize technologies such as infrared and capacitive sensing.

**Biomechanics Research**

Our National Transportation Biomechanics Research Center (NTBRC) conducts a wide variety of research projects to develop a better understanding of occupant injury mechanisms and tolerances in the automotive crash environment. Injuries attributed to contact with the vehicle's occupant compartment and various restraint systems have been investigated through both experimental testing and computational analyses. Results from this research provide the basis for the development of safety standards, injury criteria, anthropomorphic dummies, and injury mitigating countermeasures. Biomechanics research is organized into four distinct areas of concentration:

-- Crash Injury Research and Engineering Network (CIREN),

-- analytical modeling and simulation,

-- experimental impact injury research, and

-- anthropomorphic dummy development.

The Crash Injury Research and Engineering Network, CIREN, has been created to enable physicians, emergency medical services (EMS) professionals, and engineers to better understand mechanisms of crash injury. The network is comprised

of seven trauma centers from around the country, each with particular areas of medical expertise and research interests. These centers include The University of Michigan Medical Center in Ann Arbor, Michigan; the National Study Center for Trauma and Emergency Services in Baltimore, Maryland; the William Lehman Injury Research Center, Ryder Trauma Center in Miami, Florida; the University of Medicine and Dentistry of New Jersey, in Newark, New Jersey; the Harborview Injury Prevention and Research Center in Seattle, Washington; the San Diego County Trauma System in San Diego, California; and the Children's National Medical Center in Washington, D.C.

The implementation of the CIREN network has enabled medical researchers at the seven centers to begin to work in collaboration with researchers in government, industry and academia to provide a multidisciplinary approach to crash injury control. The common computer network linking the seven centers and NHTSA, which will be completed by this spring, is expected to produce (1) common data formats and retrieval methods for collecting, storing, and retrieving crash injury information; (2) comprehensive and detailed vehicle and patient data from about 350 crashes per year; (3) a database for controlled access by medical and automotive engineering researchers worldwide to study crashes, injuries, and medical outcomes; (4) multidisciplinary case reviews to improve the understanding of crash biomechanics by physicians and the medical consequences of crashes by engineers; and (5) broad dissemination of research results across the specialties and training of new researchers.

The CIREN network will provide the medical and engineering communities with an early-warning system to detect emerging injury patterns associated with design changes in vehicles and highways. Clinicians will have access to crash information, and the automobile industry will have information with which to design safer vehicles. Finally, governments worldwide can use these results to increase the safety of their citizens.

Analytical Modeling and Simulation has focused primarily on the development and validation of finite element models of the human anatomy. Detailed models have been developed of the head, neck, thorax, lower extremities, and foot/ankle complex. These models include all of the biomechanically significant anatomic structures, including bone, cartilage, ligament, and muscle. In addition to the finite element models being developed, simulations have also been conducted using multi-body dynamics. These models typically represent the full human body as a number of rigid bodies, joined together by a combination of joints.

Computational simulations have provided insight into the complex mechanism of automotive crash related trauma. A number of specific injury mechanisms have been investigated through computational simulations, including:

- serious brain injury resulting from upper interior impact,
- diffuse axonal injury resulting from rotational acceleration of the head,
- serious cervical spine injury caused by compressive loading due to head impact,
- minor neck injury caused by rear impact whiplash conditions,
- thoracic trauma caused by seat belt loading and side impact,
- thoracic trauma resulting from out-of-position air bag deployment, and
- ankle injury resulting from floor pan intrusion.

Experimental Impact Injury Research provides critical data on injury mechanisms and tolerances for a variety of loading configurations. Since it is impossible to subject human volunteers to injurious crash situations, testing on cadaveric specimens provide the closest similarity. Anthropomorphic dummy tests are also conducted to relate human injury phenomena to a more repeatable and robust test system. There are currently over 1,400 human surrogate tests and 2,250 dummy tests contained within the Biomechanics Database. This test data, along with analytical simulations, has highlighted a number of injury mechanisms for various regions of the body.

In 1984, the results from 49 side impact cadaver tests were published. These data indicated that injuries to the rib cage and the underlying organs are strongly related to the peak lateral acceleration experienced by the struck side ribs and the lower thoracic spine. Subject age and mass also had an influence on the susceptibility to injury. A relationship called the Thoracic Trauma Index (TTI) was developed based on these experimental results.

One major achievement which has dramatically improved our ability to measure the response of the thorax to impact conditions was the invention of the External Peripheral Instrument for Deformation Measurement in 1989. This device, more commonly

referred to as the chestband, consists of a thin steel band instrumented with strain gage bridges located every inch along its length. These devices can be wrapped around a test subject's torso like a belt to record changes in curvature for each gage location around the circumference. Output from the gages are input into an analysis program called EBAND-PC, which calculates the cross-sectional shape of the torso dynamically during an impact event.

In 1990, data from 126 cadaver tests and 222 Hybrid III dummy tests were used to establish a femur load tolerance for a variety of different test conditions. From these tests, it was shown that femur force alone could distinguish between injurious and non-injurious loading scenarios, although a combination of femur force and the rise time of the force was a better predictor of femoral injury. A femur force tolerance value of 12 kN was associated with a 21% risk of femur fracture.

In 1991, 480 in-depth real world crash reports were examined. It was found that lower extremity injuries were 26 percent of the total AIS 3 or greater injuries. For most of these foot/ankle injuries the amount of floor pan intrusion was low. This suggested a prominent foot/ankle injury mechanism associated with a slapping force to the foot.

In 1995, a paper was presented at the 39th Stapp Conference describing the response of the torso to a variety of seat belt and air bag combinations. Results from 13 cadaver and 4 dummy tests were shown air bags alone and in combination with standard seat belts (6% elongation), compliant seat belts (16% elongation), and 4kN and 5kN force-limiting seat belts. The results showed that for the standard and compliant seat belt systems in combination with an air bag, the thoracic injuries were located along the shoulder belt. A minimal benefit was gained from the presence of an air bag. Test results using force-limiting seat belts showed the potential for achieving the benefits of an air bag, while still maintaining the multi-directional benefits of being restrained by a seat belt.

In 1996, the results from 52 foot/ankle tests were reported. These tests looked at a number of biomechanical parameters to ascertain their relationship to lower extremity injuries. Statistical analyses indicated that the two most significant variables were dynamic axial force and subject age. Research into the mechanisms and tolerances of the foot/ankle complex are continuing, looking at a number of other parameters such as loading rate and initial position of the foot. To date, over 100 tests have been conducted to investigate lower extremity injuries.

In 1997, data from 22 cadaver head/neck specimens were presented at the 41st Stapp Conference. These tests highlighted the complex coupling that exists between the head and neck, as well as the buckling behavior of the cervical spine. Results showed a significant difference between the load tolerance of males and females. According to thisstudy, the female failure load was roughly 1.0 kN, while for the male it was more than double this value.

Understanding the complex response and interactions of the human body during an automotive impact event is a difficult task. As discussed above, real world crash investigations, analytical modeling, and experimental impact testing have attempted to develop this knowledge. However, before this can be applied to a regulation, a robust and repeatable test device must be available. NHTSA Biomechanics has conducted several major initiatives in the area of anthropomorphic dummy development.

In 1992, a collaborative research project with the University of Michigan Transportation Research Institute was completed. This project was to develop and test a new thorax assembly that would improve dummy performance with regard to restraint system interaction and injury sensing capability for the chest and abdomen. New features of this dummy thorax, known as the Trauma Assessment Device (TAD), included a rib cage with more human-like geometry based on the anthropometry study of 1983. Also included were an articulated thoracic spine, shoulders with load bearing clavicles connected to a sternum with improved range of motion, a frangible abdomen, and a chest deflection measurement system capable of monitoring three-dimensional displacements of the rib cage at multiple locations.

Following on to the TAD thorax development, a new complete frontal dummy, known as the Test-device for Human Occupant Restraint (THOR), was developed and presented at the 1996 ESV Conference. This new complete dummy incorporates all of the latest knowledge acquired from NHTSA's biomechanical testing and simulation. Almost every part of the body was completely re-designed, and exhibits a more biofidelic response than its predecessor. The THOR dummy is currently undergoing a thorough evaluation from numerous international collaborators. Enhanced instrumentation in all anatomic regions of the dummy allows for the collection of vast amounts of data critical to the prediction of injuries. Following evaluation of the mid-sized male THOR dummy, a family of adult dummies will be developed.

Another area in which the National Transportation Biomechanics Research Center has been active is hosting scientific conferences and workshops. Every year, scheduled around the Stapp Car Crash Conference, the International Workshop on Human

Subjects for Biomechanical Research is held. This Workshop celebrated its 25th anniversary back in November. It is a forum in which biomechanics researchers from around the world can present current work in progress. Receiving feedback from colleagues during the early stages of a research program can help correct problems or limitations in experimental protocols. This also helps to maximize the benefit derived from human subjects testing and to avoid wasting specimens. Papers presented at the Human Subjects Workshop are commonly presented at other scientific conferences, such as the Stapp Conference, once the testing program is completed.

Two additional scientific conferences have also been hosted by NHTSA Biomechanics. In 1994, co-hosted by George Washington University, the International Symposium on Head Injury Research was held in Washington, DC. This conference was designed to provide a forum for the comprehensive discussion of issues related to traumatic brain injury (TBI) and skull fracture. Topics covered included epidemiology of TBI, injury mechanisms, computational and experimental biomechanics, and aspects of treatment and outcome following closed head injury.

In 1995, NHTSA co-hosted the International Conference on Pelvic and Lower Extremity Injuries along with the Maryland Shock Trauma Center and the University of Virginia. This conference was prompted by earlier highway traffic injury studies which provided evidence that pelvic and lower extremity injuries, while not necessarily life-threatening, contributed significantly to the cost and morbidity associated with traumatic injuries. The success of air bags in reducing fatalities and injuries to the head and chest, meant that occupants were surviving more severe crashes, often with severe injuries to the lower extremities. The purpose of this conference was to bring together professionals involved in research, policy, injury prevention and treatment of lower extremity injuries to exchange information and ideas. The conference provided an opportunity for those involved in this work internationally to take stock of ongoing activities and to identify gaps where new research or programs were needed.

### In-House Testing

NHTSA's in-house testing laboratory, the Vehicle Research and Test Center (VRTC), located in East Liberty, Ohio, has continued to be an integral part of the agency team since the last ESV conference. VRTC conducts programs in crashworthiness, biomechanics, crash avoidance and defect investigations.

In the biomechanics area, VRTC has been involved in bringing the wide array of Hyrid III dummy sizes into NHTSA safety standards. In addition to the $50^{th}$ male, the $5^{th}$ female, and 3 and 6 year old dummies are being finalized for standards as well as the 12 month old CRABI. A report of child and adult injury criteria was prepared and sent outside the agency for comment. In addition, a survey of vehicles and child restraints was completed, and a CD ROM was prepared for public use assisting parents in identifying which seats are compatible with their vehicle and how to properly install the child restraints.

In the area of vehicle crashworthiness, VRTC conducted testing with baseline and next-generation air bags, which provided the basis for the regulation changes in FMVSS 208. Sled test procedures were developed to replace full scale crash testing as an interim procedure which allows new-generation air bags. Advanced air bag restraint concepts are currently being evaluated. Also, advanced side glazing systems have been developed which minimize ejection and laceration potential in side and rollover crashes. A series of tests to evaluate the agressiveness of light trucks has been performed, and the results are currently being evaluated.

In the crash avoidance area, VRTC has developed a comprehensive research plan to evaluate the performance of ABS brakes and determine why highway performance has been successful. The research is underway, with approximately half of the 3 years of effort completed. An evaluation of potential test procedures to measure rollover propensity has been performed, and preparations have begun to conduct rollover testing of a subset of the vehicle fleet. Also, an unobtrusive data gathering package has been developed which could be used in volunteer and government vehicles to assess driver performance and behavior. This package, called DASCAR, will be useful in many current and future driver behavior studies. (See ITS section for additional information.)

Over 40 investigations of alleged vehicle defects have been performed at VRTC. The engineering analysis of the presence and consequences of the defects was reported to the Office of Safety Assurance for appropriate action.

## INTERNATIONAL HARMONIZATION

Recognition of the need for globally harmonized motor vehicle safety regulations has been reflected in many symposia held around the world over the years. The United States continues to be involved in regional and worldwide regulatory harmonization efforts such as those of the United Nations' Economic Commission

for Europe Working Party on the Construction of Vehicles (WP.29); the Asia Pacific Economic Cooperation's Transportation Working Group (APEC-TPT); and the Automotive Standards Council of the North America Free Trade Agreement (ASC-NAFTA). This is in addition to its involvement in the International Harmonized Research Activities (IHRA). Since the last ESV Conference, significant progress has been made within these fora with respect to the harmonization of motor vehicle safety and environmental regulations.

**International Harmonized Research Activities (IHRA)**

Since the last ESV Conference, NHTSA has been working with its international partners to conduct research, establish priorities, and to carry out the agreements reached during the 15th ESV Conference in Melbourne -- International Harmonized Research Activities (IHRA).

The IHRA Steering Committee has met every six months to review recommendations and research plans being developed by the five working groups. In May of 1997, NHTSA, in conjunction with the IHRA Committee, hosted a Public Workshop to share with its partners the goals and objectives of IHRA. The first status reports on progress to date will be presented during this ESV Conference by the five lead country representatives. IHRA research programs include: advanced offset frontal crash protection, intelligent transportation systems, vehicle compatibility, biomechanics, and pedestrian safety.

**UN/ECE/WP.29**

Under WP.29, the harmonization efforts of passenger car brakes have led to a greater compatibility among the European, Japanese and US brake regulations. The United States will be using this harmonized regulation as pilot for the regulatory actions required with regard to certifications for those regulations that are harmonized or assessed as functionally equivalent. There has also been progress with respect to the installation of lighting and light-signaling devices on passenger cars conforming to regulatory requirements of the ECE, the US and Japan. Further, work is expected to continue with respect to the consideration of a harmonized passing beam pattern and glare of headlamps. Most importantly, however, significant progress has been made with respect to the establishment of a process for harmonizing and developing global technical regulations.

**Agreement on Global Technical Regulations**

During the November 1997 Session of WP.29, confirming the determination to conclude the agreement for establishing global technical regulations to the satisfaction of all parties in the most effective way, the Working Party requested that the representatives of the United States, the EU and Japan prepare by a joint effort and through informal meetings, a new revision of the proposed agreement. The Working Party also requested the Secretariat to circulate it for consideration by other members during the March 1998 session.

During the March 1998 Session of WP.29, the three parties announced that they reached accord on a text to present to the participants of WP.29. The text remains conditioned upon approval of respective authorities. The draft reflects a number of very difficult compromises on all sides, as it involved the union of three very different regulatory systems into one document. It also builds on the many suggestions and formal comments made by other participating countries. Written comments on the current draft were accepted through April 30, 1998, and will be made available for final discussion and negotiation by all interested parties during the June 1998 meeting of WP.29. It is anticipated that a final text will be officially open for signature at that time.

Thus, in the near future, a transparent process for developing global regulations concerning motor vehicle safety will be available and open to participation of all interested countries. The contributions of both developed and developing countries to the process will result in regulations that are adaptable to each country's needs. This process will provide an unprecedented opportunity for cooperative work regarding the development of regulations to serve and protect the respective citizens and environment of participating countries while providing a predictable regulatory framework for a global industry.

**Asia Pacific Economic Cooperation**

NHTSA continues to be involved with APEC harmonization projects, as a regular participant in meetings and a contributing member to the development and administration of harmonization activities. Of significance is the Road Transport Harmonization Project (RTHP), which began in 1994, and whose objective is to promote standards harmonization within APEC countries through the collection and analysis of vehicle regulations applied by each of the APEC economies to identify commonalities and divergences. The project

commissioned a consultant to conduct the analysis of commonalities and divergences among identified 71 regulations and to conduct comparisons of functional equivalence models and certification requirements used within the various economies.

The results of this project are of great value to member economies as they establish priorities for harmonization, functional equivalence assessments and marketing decisions. APEC is also keeping abreast of proposals presented by WP29 with respect the Agreement on Global Technical Regulations and other activities under the 1958 Agreement. A seminar was held in April 1998 in Mexico City in order to coordinate efforts.

### North America Free Trade Agreement

NHTSA's involvement in NAFTA harmonization efforts is through the Automotive Standards Council. The Council has been working for 2-3 years in order to (1) identify incompatibilities in standards among NAFTA countries; and (2) set up a process that addresses these incompatibilities. Working groups comprised of government and industry personnel have been organized to facilitate the process. These groups have begun working together to make recommendations to resolve current incompatibilities and to identify future divergences.

### Functional Equivalence Assessment

On May 13, 1998, NHTSA published a final rule reaffirming the agency's policy of focusing its international harmonization activities on identifying and adopting those foreign regulations that clearly reflect best practices which can provide enhanced safety. The rule amended Part 553, Rulemaking Procedures, of the CFR, by adding a new Appendix setting forth the process in the form of a flowchart which the agency believes meets the concerns expressed in the written public comments and at the public workshop held in January 1997. The agency intends to follow this process in considering whether to commence rulemaking proceedings based on petitions for functional equivalence determination. The final rule also emphasizes the agency's policy to deny any such rulemaking petition if the petition does not contain an analysis of the relative benefits of the two regulations as outlined in the process.

### Other Harmonization Activities in the US

The House and Senate Appropriations Committees directed NHTSA to begin work on establishing a frontal offset standard and developing a plan for achieving harmonization of the side impact standard. During the fiscal year 1998 hearings, NHTSA submitted reports to the Committees outlining the agency's standards development and harmonization efforts with current European and Australian offset crash and side impact regulations. NHTSA is currently working on implementing the plan. The functional equivalence process is a major step of the plan, which includes comparative compliance testing and data analyses.

In summary, the harmonization of regulations has become a matter of increasing importance in the last decade. Efforts to coordinate regulatory practices on a global scale have resulted in establishment of fora and agreements to promote and guide the process of harmonization. NHTSA has been responsive by actively participating in many of these fora while ensuring that any harmonization activity improves the levels of safety and environmental protection.

## SAFETY PERFORMANCE STANDARDS

Since the last ESV Conference in Australia, NHTSA has published many new rulemakings. These have included several related to occupant crash protection. The following is a computation of the more significant, ordered in three areas: Crashworthiness, Crash Avoidance, and Consumer Programs.

### Crash Avoidance

- On July 11, 1996 a Final Rule was published in response to petitions for reconsideration, to amend the reservoir requirements in FMVSS 121, "Air Brake Systems," for trucks, buses, and trailers equipped with air brakes to clarify the reservoir requirements.

- On July 12, 1996 a Final Rule was published rescinding FMVSS 126, "Truck-camper Loading," and combining its provisions with Part 575.103, Truck-camper Loading. This action makes their respective requirements easier to understand and apply.

- On August 8, 1996 a Final Rule was published amending FMVSS 108, "Lamps, Reflective Devices, and Associated Equipment," to require that the rear of truck tractors be equipped with retroreflective material similar to that required on the rear of the trailers they tow, to increase nighttime conspicuity and reduce rear end crashes.

- On August 29, 1996 a Final Rule was published to amend FMVSS 108, "Lamps, Reflective Devices, and Associated Equipment," to improve the photometric requirements for motorcycle headlamps.
- On September 23, 1996 a Final Rule was published specifying the location, labeling, color, activation protocol, and photometric intensity of antilock brake systems (ABS) malfunction indicator lamps on the exterior of trailers and trailer converter dollies, under FMVSS 121, "Air Brake Systems."

- On September 24, 1996 a Final Rule was published to transfer most of the requirements of FMVSS 112, "Headlamp Concealment Devices," to FMVSS 108, "Lamps, Reflective Devices, and Associated Equipment," and rescinding the remaining requirements.

- On November 15, 1996 a notice of proposed rulemaking (NPRM) was published to amend FMVSS 118, "Power Operated Window, Partition, and Roof Panel Systems," to improve the safety of children. The amendment would require each power operated window, interior partition and roof panel in a motor vehicle to be equipped with a switch designed so that contact by a form that represents a child's knee would not cause the window, partition, or panel to close.

- On November 29, 1996 a Final Rule was published in response to a petition for reconsideration from the Flexible Corporation to amend FMVSS 121, "Air Brake Systems," with respect to the air pressure at which a bus's air compressor must automatically activate.

- On January 8, 1997 a notice of proposed rulemaking (NPRM) a proposed a new standard FMVSS 100, "Low Speed Vehicles," which would establish classification and safety regulations for small, lightweight, 4-wheeled vehicles that are used on the public roads.

- On March 10, 1997 as a result of a negotiated rulemaking, a Final Rule was published to amend FMVSS 108, "Lamps, Reflective Devices, and Associated Equipment," to improve the accuracy of motor vehicle headlamp aim when headlamps are aimed visually and/or optically.

- On August 6, 1997, in response to a petition for rulemaking from Transpec Corporation, a notice of proposed rulemaking (NPRM) was published to amend FMVSS 131, "School Bus Pedestrian Safety Devices," to permit the use of additional light sources on the surface of retroreflective stop-signal arms.
- On September 5, 1997 a Final Rule was published to amend FMVSS 105, "Hydraulic and Electric Braking Systems," and FMVSS 135, "Passenger Car Brake Systems," to assure the safe performance of brake systems in electric vehicles. The rule addresses the unique characteristics of brake systems on these vehicles, such as regenerative braking.

- On September 30, 1997 a Final Rule was published to extend the stopping distance requirements in FMVSS 135, "Passenger Car Brake Systems," to trucks, buses, and multipurpose passenger vehicles with a gross vehicle weight rating (GVWR) of 3,500 kilograms or less.

- On February 19, 1998 a Final Rule was published to amend FMVSS 108, "Lamps, Reflective Devices, and Associated Equipment," to permit white reflex reflectors designed to be mounted horizontally in trailer and truck tractor conspicuity treatments to be mounted vertically in upper rear comer locations if they comply with appropriate photometric requirements.

- On March 16, 1998 a Final Rule was published to amend FMVSS 105, "Hydraulic and Electric Braking Systems," permitting hydraulically-braked vehicles with a gross vehicle weight rating (GVWR) greater than 10,000 pounds but less than 19,501 pounds to be equipped with a single wheel speed sensor in the drive line to control wheel slip at the drive axle and permits rear tag axles to lock up. In addition, this allows motor homes with a GVWR of 22,500 pounds or less to use a single rear drive axle wheel speed sensor if they are manufactured before March 1, 2001, after which new motor homes must meet the same ABS requirements as other hydraulically-braked trucks and buses.

**Crashworthiness**

- On June 18, 1996, in response to petitions for reconsideration, a Final Rule was published on FMVSS 213, "Child Restraint Systems," to correct or clarify provisions of the July 1995 Final Rule to permit manufacturers to produce belt-positioning

seats with a mass on up to 4.4 kg and to permit them to use the word "mass" in labeling child seats.

- On June 19, 1996, an announcement of a public meeting was published to seek information from school bus manufacturers, school transportation providers, and other members of the public on issues related to the transportation of school children.

- On July 29, 1996, in response to a petition for rulemaking, a notice of proposed rulemaking (NPRM) was published on FMVSS 208, "Occupant Crash Protection," proposing a limited extension of the compliance date of a recent rule improving safety belt fit by requiring that Type 2 safety belts installed for adjustable seats in vehicles with a gross vehicle weight rating (GVWR) of 10,000 lbs or less either be integrated with the vehicle seat or be equipped with a means of adjustability to improve the fit and increase the comfort of the belt for a variety of different sized occupants.

- On July 31, 1996, in response to petitions for reconsideration, a Final Rule was published on FMVSS 206, "Door Locks and Door Retention Components," granting the request for a phase-in of the compliance date of the new requirements and established the usual reporting and record keeping requirements necessary for enforcement of a phase-in and clarified the definition of "trunk lid" with respect to vehicles in which the seatbacks of rear seats fold down to provide additional cargo space; other requests denied.

- On August 6, 1996, a notice of proposed rulemaking (NPRM) was published on FMVSS 208, "Occupant Crash Protection," to reduce the adverse effects of air bags, especially those on children.

- On August 12, 1996, in response to a petition for rulemaking, a Final Rule was published on FMVSS 205, "Glazing Materials," to permit the installation of a new item of motor vehicle glazing, Item 4A - Rigid Plastic for Use in Side Windows, in motor vehicles.

- On August 30, 1996, in response to a petition for rulemaking, a notice of proposed rulemaking (NPRM) was published on FMVSS 208, "Occupant Crash Protection," proposing a provision which specifies that during crash tests, all portions of the test dummy must remain in the vehicle throughout the test.

- On September 6, 1996, in response to petitions for reconsideration, a Final Rule was published on FMVSS 304, "CNG Fuel Container Integrity," modifying the labeling requirements with respect to the inspection interval and deleted reference to certain pamphlets.

- On September 10, 1996, in response to petitions for rulemaking, a notice announcing a public meeting on FMVSS 213, "Child Restraint Systems," on a workshop to explore issues relating to improving child safety by establishing requirements for universal child restraint anchorage systems.

- On September 24, 1996, a notice of proposed rulemaking was published on part 572, "Anthropomorphic Test Dummy," proposing specifications for the side impact test dummy and the procedure in the agency's side impact protection standard for positioning the dummy in a vehicle for compliance testing purposes: 1) add plastic inserts-spacers to the dummy's lumbar spine and 2) specifies that the ribcage damper piston of the dummy is set during the dummy positioning procedure to the fully extended position prior to the side impact dynamic test.

- On November 27, 1996, a Final Rule was published on FMVSS 208, "Occupant Crash Protection," requiring new attention-getting labels to reduce the adverse effects of air bags unless the vehicles have a "smart" passenger-side air bag.

- On December 12, 1996, a request for comments was published on FMVSS 202, "Head Restraints," requesting comments on a Technical Report titled, "Head Restraints–Identification of Issues Relevant to Regulation, Design, and Effectiveness.

- On December 26, 1996, in response to several petitions for rulemaking, a Final Rule was published on part 572, Anthropomorphic Test Dummy," amending the specifications for the Hybrid III compliance test dummy.

- On January 2, 1997, a technical amendment was published on FMVSS 208, "Occupant Crash Protection," correcting errors in warning label

requirements in the final rule published on November 27, 1996.

- On January 6, 1997, a Final Rule was published on FMVSS 208, "Occupant Crash Protection," extending until September 1, 2000, the time period during which vehicle manufacturers are permitted to offer manual cutoff switches for the passenger-side air bag for vehicles without rear seats or with rear seats that are too small to accommodate rear facing infant seats.

- On January 6, 1997, a notice of proposed rulemaking (NPRM) was published on FMVSS 208, "Occupant Crash Protection," proposing occupant protection standard to ensure that vehicle manufacturers can redesign all air bags so that they inflate less aggressively.

- On January 6, 1997, a notice of proposed rulemaking (NPRM) was published on FMVSS 208, "Occupant Crash Protection," proposing as part of its efforts to address the problem of the adverse effects of current air bag designs on children and certain adults, to make it possible for vehicle owners to have their air bags deactivated by vehicle dealers and repair businesses.

- On January 10, 1997, in response to a petition for rulemaking, a Final Rule was published on FMVSS 208, "Occupant Crash Protection," granting a four-month extension of the date by which vehicles with a gross vehicle weight rating (GVWR) of more than 8,500 pounds and less than 10,000 pounds must comply with the requirements for safety belt fit.

- On January 21, 1997, a notice announcing a public workshop on FMVSS 208, "Occupant Crash Protection," to explore technical issues relating to the occupant protection standard and smart air bags.

- On February 20, 1997, in response to several petitions for rulemaking, a notice of proposed rulemaking (NPRM) was published on FMVSS 213, "Child Restraint System," proposing to require motor vehicles and add-on child restraints be equipped with a means independent of vehicle safety belts for securing the child restraints to vehicle seats.

- On February 27, 1997, a request for comments was published on FMVSS 208, "Occupant Crash Protection," seeking comments on whether to amend the provisions in the standard concerning the use of unbelted as well as belted dummies in testing air bag-equipped vehicles.

- On March 19, 1997, a Final Rule was published on FMVSS 208, "Occupant Crash Protection," to temporarily amend the standard to ensure that vehicle manufacturers can quickly redesign all air bags so that they inflate less aggressively.

- On April 8, 1997, in response to several petitions for reconsideration, a Final Rule was published on FMVSS 201, "Occupant Protection in Interior Impact," to include another phase-in option, allowing manufacturers to carry forward credits for vehicles certified to the new requirements prior to the beginning of the phase-in period, exclude buses with a gross vehicle weight rating (GVWR) of more than 8,500 pounds, specifying that all attachments to the upper interior components are to remain in place during compliance testing, and making other changes to the test procedure clarifying some areas of confusion.

- On April 17, 1997, in response to a request from an automobile manufacturer, an Interim Final Rule; request for comment was published on FMVSS 213, "Child Restraint Systems" modified the air bag warning label which rear-facing child seats are required to bear beginning May 27, 1997, and requested comments on this amendment.

- On April 21, 1997, a notice or proposed rulemaking (NPRM) was published proposing Phase II of metric measurements conversion from English.

- On May 14, 1997, in response to a request from AAMA, an Interim Final Rule; request for comments was published on FMVSS 208, "Occupant Crash Protection," a temporary amendment to ensure that vehicle manufacturers can quickly redesign all air bags so that they inflate less aggressively and requested comments on this amendment.

- On May 20, 1997, an Interim Final Rule; request for comment was published on part 572, "Anthropomorphic Test Dummy," adopting modifications to the Hybrid III test dummy, which is specified by the agency for use in compliance testing under FMVSS 208, "Occupant Crash Protection," to require a six axis neck transducer to

ensure compliance with the recent amendment to allow air bag redesign and requests comments on this final rule.

- On May 20, 1997, a request for comment was published seeking comments on the agency's response to the recommendations of the National Academy of Sciences study titled "Shopping for Safety–Providing Consumer Automotive Safety Information."

- On May 20, 1997, in response to a petition for rulemaking, the agency will evaluate concerns for emergency handling test (for sport-utility vehicles) as the agency continues to be interested in rollover safety.

- On May 30, 1997, in response to petitions for rulemaking, a notice of proposed rulemaking (NPRM) was published on FMVSS 304, "CNG Fuel Container Integrity," proposing to delete the material and manufacturing process requirements because of the most recent proposed voluntary industry standard.

- On June 5, 1997, in response to a request from an automotive manufacturer, an Interim Final Rule; request for comment was published on FMVSS 213, "Child Restraint System," to modify the air bag warning label which rear-facing child seats are required to bear and requested comments on this amendment.

- On July 7, 1997, in response to a petition for rulemaking, a notice of proposed rulemaking (NPRM) was published on FMVSS 209, "Seat Belt Assemblies," proposing to delete the requirement in S4.1(b) that the lap belt portion of a safety belt system be designed to remain on the pelvis under all conditions.

- On August 7, 1997, a notice of proposed rulemaking (NPRM) was published on part 572, "Anthropomorphic Test Dummy," proposing minor modifications to the test dummy's clothing and shoes and the hole diameter in the femur flange in the pelvis bone flesh to facilitate compliance testing.

- On August 20, 1997, in response to a petition for rulemaking, a Final Rule; Technical Amendment was published on part 572, "Anthropomorphic Test Dummy," correcting the specification characteristics of the test dummy representing a six-year-old child.

- On August 26, 1997, a notice of proposed rulemaking (NPRM) was published on FMVSS 201, "Occupant Protection in Interior Impact," proposing to permit, but not require, the introduction of dynamic head protection systems currently being developed by vehicle manufacturers to provide added lateral crash protection.

- On August 26, 1997, as a request from AAMA, an Interim Final Rule was published on FMVSS 208, "Occupant Crash Protection," to further amend the occupant crash protection standard, so that a special, less stringent test requirement in the related standard, interior protection, that applies to vehicle certified to the unbleted barrier test will also apply to vehicles certified to the alternative sled test.

- On November 21, 1997, a Final Rule was published on FMVSS 208, "Occupant Crash Protection," allowing motor vehicle dealers and repair businesses to install retrofit manual on-off switches for air bags in vehicles owned by or used by persons whose requests for switches have been approved by the agency.

- On December 1, 1997, a Termination was published on FMVSS 301, "Fuel System Integrity," terminating rulemaking in which the agency had considered to limit fuel spillage experienced by vehicles equipped with a crossover fuel line.

- On December 8, 1997, a notice of proposed rulemaking (NPRM) was published on part 572, "Anthropomorphic Test Dummy," specifying requirements for a newly developed anthropomorphic test dummy for compliance testing of head impact protection.

- On December 30, 1997, a Final Rule was published on FMVSS 208, "Occupant Crash Protection," correcting language of the regulatory text to clarify the requirement of key specifically matched to the on-off switch and how the readiness indicator should function when one or both air bags have been deactivated by means of the on-off switch.

- On January 26, 1998, in response to a petition for rulemaking, a Final Rule was published on FMVSS 208, "Occupant Crash Protection," amending the requirements for seat belts at forward-facing rear outboard seating positions of police cars and other law enforcement vehicles to facilitate the transporting of prisoners.

- On January 26, 1998, in response to petitions for reconsideration, a Final Rule was published on FMVSS 223, "Rear Impact Guards" and FMVSS 224, "Rear Impact Protection,"to clarify the 100mm (4 inch) height requirement for the horizontal member of an underride guard, explicitly exclude from having to meet the energy absorption requirements all cargo tank motor vehicles manufactured with rear end protection complying with the high strength requirements of 49 CFR part 178 (to protect hazardous material) that occupies the area specified for the underride guard, and increases the acceptable range of force application rates during testing. This excludes pulpwood trailers from the application of the vehicle standard and denies a petition to extend the effective date of the final rule published January 24, 1996.

- On February 4, 1998, in response to petitions for reconsideration, a Final Rule was published on part 572, "Anthropomorphic Test Dummy," making minor modifications in the dummy's femurs and ankles to improve biofidelity.

- On April 2, 1998, a Final Rule was published on FMVSS 208, "Occupant Crash Protection" and part 572, "Anthropomorphic Test Dummy," making two amendments to the specifications for the side impact test dummy and the procedures in the side impact protection standard for positioning the dummy in a vehicle for compliance testing purposes.

- On April 2, 1998, in response to a petition for rulemaking, a withdrawal was published on FMVSS 208, "Occupant Crash Protection," withdrawing the proposed rulemaking which considered allowing partial ejection of the Hybrid III dummy during crash tests.

**Consumer Programs**

- On September 3, 1996, in response to petitions for rulemaking, a request for comments was published on part 583, "Automotive Parts Content Labeling," the agency made a limited, temporary amendment to its content calculation procedures to provide vehicle manufacturers added flexibility in making content determinations where outside suppliers have not responded to requests for content information; and requested comments on whether to provide this or similar added flexibility for a longer period of time.

- On September 9, 1996, a Final Rule was published on part 575.104, "Uniform Tire Quality Grading (UTQGS)," revising the treadwear testing procedures to maintain the base course wear rate of course monitoring tires at its current value of 1.34.

- On January 3, 1997, a notice of proposed rulemaking (NPRM) was published on part 538, "Manufacturing Incentives for Alternative Fuel Vehicles," proposing to set the minimum driving range only for dual fueled electric passenger automobiles, otherwise know as hybrid electric vehicles (HEVs) at 17.7 miles when operating on electricity alone.

- On April 3, 1997, a Final Rule was published on part 533, "Light Truck Fuel Economy," establishing the average fuel economy standard for light trucks manufactured in model year (MY) 1999 as 20.7 mpg.

- On June 23, 1997, in response to petitions for reconsideration, a Final Rule was published on part 583,"Automotive Parts Content Labeling," extending for two years a limited, temporary provision in its content calculation procedures to provide vehicle manufacturers added flexibility in making content determinations where outside suppliers have not responded to requests for content information.

- On April 13, 1998, a notice of proposed rulemaking (NPRM) was published on part 575, "Consumer Information," proposing modification of the existing warning label required in multipurpose passenger vehicles (other than those which are passenger car derivatives) with a wheelbase of 110 inches or less advising drivers that the handling and maneuvering characteristics of these vehicles require special driving practices.

# Canada

**Nicole Pageot**
Transport Canada

Just in case you've lost count, this is the thirteenth-but last—status report you'll be hearing today. By now, our glowing accounts of past achievements and future plans for improving road safety have no doubt begun to blur in your minds. Yes, I'm about to give you yet another overview of accomplishments and renewed goals—this time for Canada.

Canada is a large country—about 9.2 million square kilometers in area-with a small population—30,000,000 people—concentrated mainly near the southern border. Its economy relies heavily on a large network of highways, about 900,000 kilometers in length.

It's been over 25 years since Canada first began to regulate road safety at the federal level and, in that time, traffic—related deaths have decreased by almost 50%. Much of this reduction can be attributed to the increased use of restraint systems—which is to say, seat belts, infant restraint systems, child restraint systems, and booster cushions. According to a 1997 survey conducted by Transport Canada, the rate of seat belt use for drivers of light-duty vehicles in Canada is over 90%. And, the proper use of child restraint systems is 76%, which represents an increase of 18% over the rate observed in 1989.

While we're very pleased with these statistics, we plan to do more—particularly with regard to infant and child restraint systems. The federal government is continuing to work in conjunction with the provinces, manufacturers, and all members of the road safety community to increase the use of infant and child restraint systems. In addition, we're working to improve their design. Our restraint systems are already among the safest in the world—they must meet strict performance requirements; tether anchorages are mandatory in all passenger cars; and as of September of the year 2000, tether anchorages will also be required in minivans, sport utility vehicles, and light trucks. However, a problem remains with regard to the correct installation of infant and child restraint systems, which we're attempting to address by conducting research to make these devices more user friendly.

At the last ESV Conference, we reported our intention to revise Canada's occupant protection requirements, and last year, we published a new regulation that sets more stringent head and chest protection criteria. In an attempt to further improve occupant protection, we've also been studying air bag performance—in particular the requirements of people who are short in stature. Over the past two years, we've conducted over 50 full-scale crash tests and close to 100 static air bag deployments, using fifth percentile female test dummies and 6-year-old Hybrid III test dummies. The purpose of most of this research, which was performed in conjunction with NHTSA, was to assess the feasibility of introducing a new offset frontal crash test. The proposed test is conducted at moderate speed, with the seats in the full forward position, using two fifth percentile female Hybrid III dummies. Dainius Dalmotas will be presenting the results of this research later in the week. As part of our assessment of air bag performance, we also examined data collected under our program of in-depth investigations of real-world collisions. The data showed clearly that first-generation air bag systems were overly aggressive to belted occupants, causing them unnecessary injuries. This problem was brought to the attention of vehicle manufacturers, who responded by introducing depowered air bag systems in the vehicles sold in Canada. We are in the process of evaluating the effectiveness of the second generation of air bags through a study of crashes involving late-model vehicles in which an air bag deployed. Preliminary results from this study will also be presented later in the week.

Although we've made, what I consider to be, excellent progress in reducing the injuries and deaths due to motor vehicle collisions, we're always looking for new ways to improve road safety. If significant further progress is to be made, I believe it will come through improvements in side impact protection. To this end, Transport Canada has been conducting research on several fronts to help establish the basis for a reliable test of side impact protection.

As part of this research, we've systematically measured and compared the responses of the different side impact dummies that are currently available, which include the US SID, the EuroSID 1, the BioSID, and—the new woman on the block—the SID-IIs. We've also been studying how well the vehicle damage patterns produced by different deformable barriers match the damage patterns observed in 100 real-world crashes. At the same time, we're comparing the injuries sustained in these crashes with the test dummy responses. Because the validity of a side impact compliance test will depend to a great extent on the biofidelity of the dummy used, Transport Canada is also participating with both the International

Harmonization Research Activities and the International Standards Organization in the development of what we hope will be the first internationally accepted side impact dummy—the WorldSID.

So far, it may appear that much of our effort over the past two years has gone into improving occupant protection. While this is true, we're also involved in a number of other interesting initiatives.

The increasing popularity of minivans, sport utility vehicles, and light trucks has led to concern about the fact that, in a collision between these larger vehicles and passenger cars, it is usually the occupants of the smaller vehicle who are injured. One important future project is to document the damage and injuries sustained in such collisions as a first step to developing a regulatory means of minimizing the injuries that are caused. The safe transportation of children to and from school has always been a high priority for Transport Canada and, over the years, we've implemented a number of safety standards specific to school buses. Although very few children are seriously injured in collisions while they are *inside* the school bus, children are still being injured by the school bus once they have disembarked. In order to improve visibility around the bus for the driver, we have recently revised our standard governing exterior mirrors in order to reduce blind spots to a minimum. These new requirements are unique to Canada.

When we first proposed to revise our occupant protection regulation, we included requirements to minimize the risk of seat-belt-induced injury. Originally, we intended to prescribe seat belt anchorage location zones using a device called the Belt-Fit Test Device, or BTD for short. In the end, we did not introduce the seat-belt fit requirements. Instead, a collaborative research program was set up with industry to develop an electronic version of the BTD that is to be used with Computer Assisted Design tools early in the design cycle. The research group has conducted preliminary validation trials comparing the performance of the physical device with the computerized version, and the results have been promising. We are especially excited by this project as the electronic BTD is a prime candidate for electronic compliance, which we hope to use more frequently in the future.

Another initiative we've undertaken attempts to explore why anti-lock braking systems have not reduced motor vehicle collisions as much as we expected. The potential of ABS to reduce collisions by improving driver control has been well documented in controlled testing environments. However, it appears that, while ABS has significantly reduced the number of multiple-vehicle collisions, there has been an increase in single vehicle collisions. We're currently studying the reasons for this unanticipated result by trying to evaluate whether drivers understand how ABS works, whether it is being used properly or not, whether anti-lock braking systems encourage risky driving behaviour, or whether a combination of these or other factors may be responsible.

We're also conducting research into providing protection to lighter vehicles that are involved in collisions with heavy vehicles—with a view to introducing heavy vehicle underride protection requirements. In a related initiative, Transport Canada is leading the development of comprehensive North American regulations for cargo security, in conjunction with the U.S. Federal Highway Administration, the Canadian Provinces, and the private sector.

In addition to our other efforts, we've also been active in the domain of Intelligent Transportation Systems, or ITS. Much of our recent work in this area has focused on leading the International Harmonization Research Activities working group, which is developing procedures for evaluating the safety of in-vehicle information, control, and communications systems.

We're also studying whether the use of cellular telephones while driving is a safety hazard. We've just completed the data collection phase using Transport Canada's Quality of Driving evaluation procedure.

Last year, we also conducted a study of behavioural adaptation to Fatigue Warning Systems. Although the preliminary results of the study provided no evidence of behavioural adaptation, the warning signals triggered by significant drowsiness had no observable effects on drivers. The results of this study underscore dramatically the need for systematic research into how human beings respond to new technologies. In this regard, the theme of the Conference, which highlights the human factor, is especially appropriate, and we are pleased to see that increasing attention is being paid to this area.

Details of much of the work I've touched on here will be presented at greater length in papers at the technical sessions, in posters, and in our display in the Exhibition Hall.

I hope you will enjoy your stay in Windsor, and I look forward to meeting you during the course of the week.